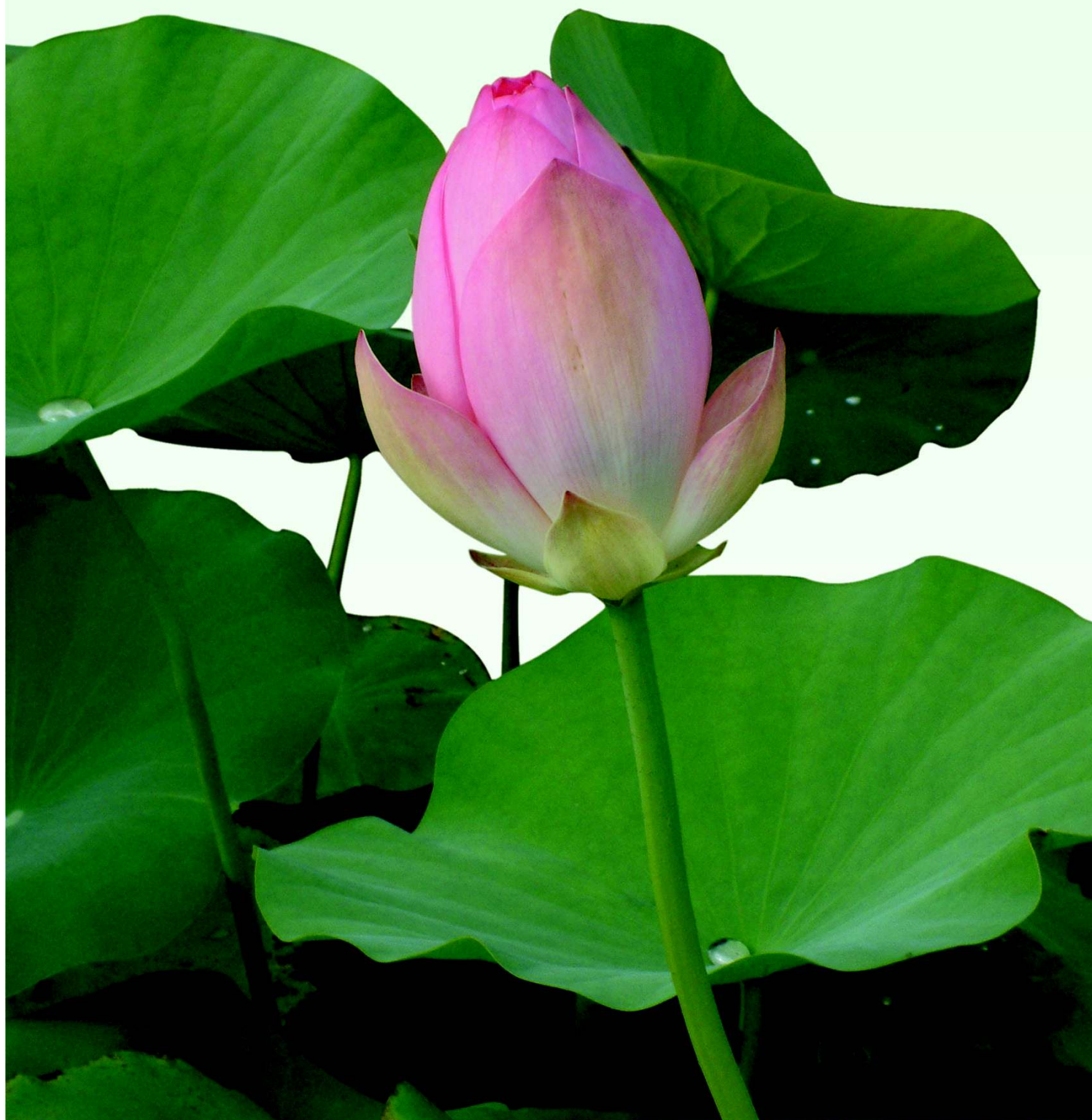


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## EDITORIAL

The first issue of the in-house journal of the Botanical Survey of India, the 'Bulletin of the Botanical Survey of India', initiated to facilitate publications of the researchers and botanists of the Survey, universities and other research institutes, appeared in 1959 under the editorship of Fr. H. Santapau, the then, Director of the Survey. The journal went on for 50 years publishing research articles concerning taxonomy and allied fields with contributions coming from the scientists of the Survey and also from other institutions. In the last fifty years, priorities and mandate of the Survey have evolved with changing situations/needs and a broad based Editorial Board was felt necessary to assist in improving the quality of articles and quicken the pace of reviewing and publishing. Further, it was felt appropriate to give a name to the journal. The Survey being the only national organization exclusively mandated for taxonomy, the name NELUMBO, the genus to which the national flower belongs to (*Nelumbo nucifera*), was felt appropriate. The present volume, numbered 51, is thus appearing under this name with a new Editorial Board.

The authors and contributors are encouraged to route their papers through any of the members of the editorial board for prompt reviewing. NELUMBO, as an international journal of plant and fungal taxonomy, will continue the earlier tradition of publishing articles from traditional taxonomy as well as from new and emerging allied branches. The journal henceforth may be referred to as Nelumbo instead of Bull. Bot. Surv. India in all citations.

The feedback from the readers is solicited to improve the quality of the publication.

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*Editor-in-Chief*

## NOTES ON *MEDINILLA* GAUDICH. (MELASTOMATACEAE) FROM GREAT NICOBAR ISLAND, INDIA

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### ABSTRACT

A new species viz. *Medinilla balakrishnanii*, allied to *M. coriacea* Merr., is described. *Medinilla speciosa* (Reinw. ex Blume) Blume is reported for the first time as an addition to the Flora of India. Detailed descriptions, ecological notes with illustration are provided.

**Keywords :** New species, New record, Great Nicobar Island, India.

### INTRODUCTION

The genus *Medinilla* Gaudich. comprises epiphytic and terrestrial shrubs and climbers and includes about 400 species. It is found throughout tropical Africa, India, Sri Lanka, Myanmar, Thailand, South China, Islands of South-East Asia, New Guinea, Northern Australia, Micronesia, Solomon Islands, Vanuatu and Fiji with its maximum diversity in the Malaysian region (Regalado 1990, 1995). In India, this genus is represented by 7 species namely *Medinilla erythrophylla* Lindl., *M. beddomei* C.B. Clarke, *M. himalayana* Hook. f., *M. pauciflora* Hook. f., *M. malabarica* Bedd., *M. sahyadrica* Sasidh. & Sujanapal and *M. anamalaiana* Sasidh. & Sujanapal distributed in the Himalayan and Peninsular regions (Sasidharan & Sujanapal, 2005).

During the floristic survey of Mt. Thullier, Great Nicobar Biosphere Reserve, a beautiful epiphytic shrub was collected from the dense evergreen forests. On studying the specimens it is found to be different and distinct from the alliance of *M. coriacea* Merr., of Philippines and hence described as new species. *Medinilla speciosa* (Reinw. ex Blume) Blume is reported as an addition to the Flora of India. Descriptions and illustrations are provided for easy identification of these species.

#### 1. *Medinilla balakrishnanii* Jayanthi, Karthigeyan, Sumathi & Diwakar **sp. nov.** (Fig. 1).

*Medinillae coriaceae* proxima, petiolis et inflorescentiss hypanthiisque furfuraceis, laminis elliptico-oblongis apice acuminato nervis supra impressis venis transversalibus prominentibus, petiolis floribusque majoribus differt.

*Type* : India, Andaman & Nicobar Islands : Great Nicobar, Mt. Thullier, Evergreen forest,  $\pm$  600 m, 2 June 2002, J. Jayanthi, K. Karthigeyan & R. Sumathi 19354 (Holo. : CAL, Iso. : PBL).

Closely allied to *M. coriacea* Merr., differing in the furfuraceous petioles, inflorescences and hypanthium, longer elliptic-oblong leaves, acuminate at apex, nerves impressed above, transverse veins prominent, larger petioles and larger flowers.

Epiphytic, scandent shrub, 3-5 m high; bark whitish; branches terete, glabrous, lenticellate, c. 1 cm in diam.; young branchlets slightly quadrangular, setose. Leaves opposite or ternate, elliptic-oblong, 10-18  $\times$  5-9 cm, exstipulate, coriaceous, drying greyish-blackish green above, chocolate brown below, acuminate at apex, entire along margins, cuneate at base, 5-7-nerved, nerves impressed above, raised below; transverse veins prominent on both surfaces; petioles ridged, 1.8-5 cm long, slightly furfuraceous. Inflorescence axillary, fascicled, few-flowered cymes, arising on leafless nodes; peduncles ridged, reddish-brown furfuraceous, 1-2.3 cm long. Flowers creamy white, c. 3  $\times$  2.5 cm, 5-merous. Pedicels ridged, pink, 3-5 mm long, reddish-brown furfuraceous. Hypanthium campanulate, green with pinkish tinge, reddish-brown furfuraceous, 1-1.3  $\times$  0.8-1 cm, 5-denticulate. Petals 5, creamy white with pink tinge along margins, membranous, imbricate, obliquely broadly elliptic-obovate, 2.5-2.8  $\times$  1-1.5 cm. Stamens 10, unequal, isomorphic; short stamens 5; filaments

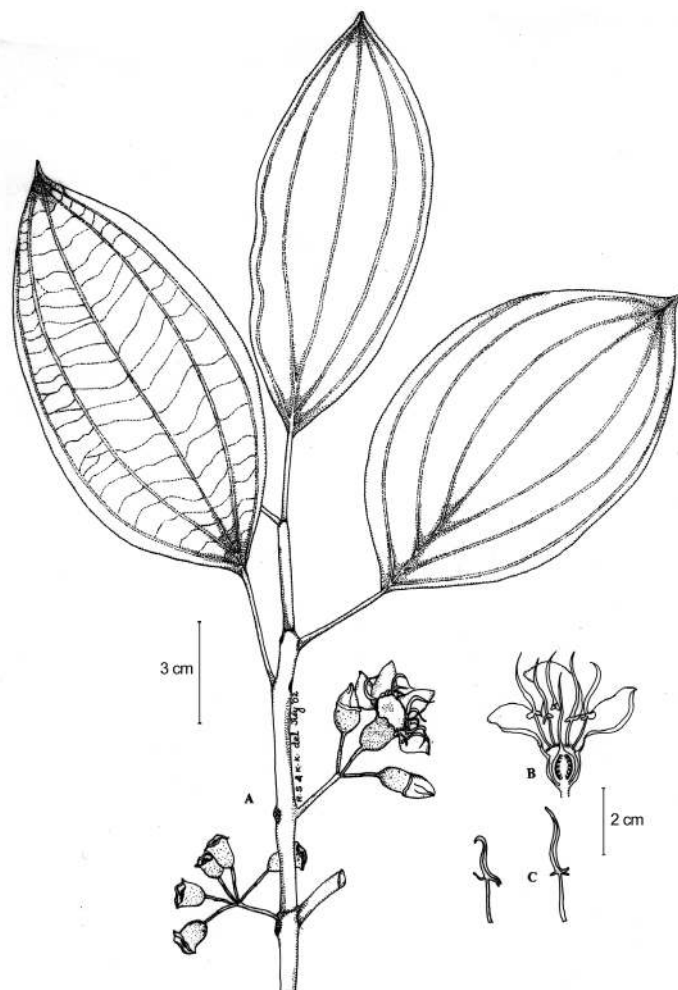
c. 1.4 cm long; anthers c. 1.2 cm long, with 2.5-3 mm long lateral appendage and c.3 mm long plectrum; longer stamens 5; filaments c. 1.7 cm long; anthers c. 1.8 cm long with c. 2 mm long lateral appendage and c. 2 mm long plectrum. Ovary 5-6-celled, placentation axile; style c. 1.5 cm long, 1-2 mm wide; stigma punctiform. Fruits not seen.

*Fl.* : May - June.

*Habitat* : Found in dense evergreen forests, exposed to partial sunlight, climbing on *Knema andamanica* (Warb) de Wilde at an elevation of  $\pm$  600 m.

The difference between *Medinilla balakrishnanii* and *M. coriacea* are elucidated below :

Characters	<i>Medinilla balakrishnanii</i>	<i>Medinilla coriacea</i>
Indumentum	Petioles, inflorescences and hypanthium furfuraceous.	Petioles, inflorescences and hypanthium glabrous.
Leaves	10-18 $\times$ 5-9 cm, elliptic-oblong, acuminate at apex.	11-12 $\times$ 5.5-6.5 cm, broadly elliptic-ovate to suborbicular, rounded to apiculate at apex.
Venation	Nerves impressed above, transverse veins prominent.	Nerves faint above, transverse veins inconspicuous.
Petioles	2.5-2.8 cm long.	Up to 1.2 cm long.
Flower	c. 3 $\times$ 2.5 cm.	c. 2 $\times$ 1.5 cm.

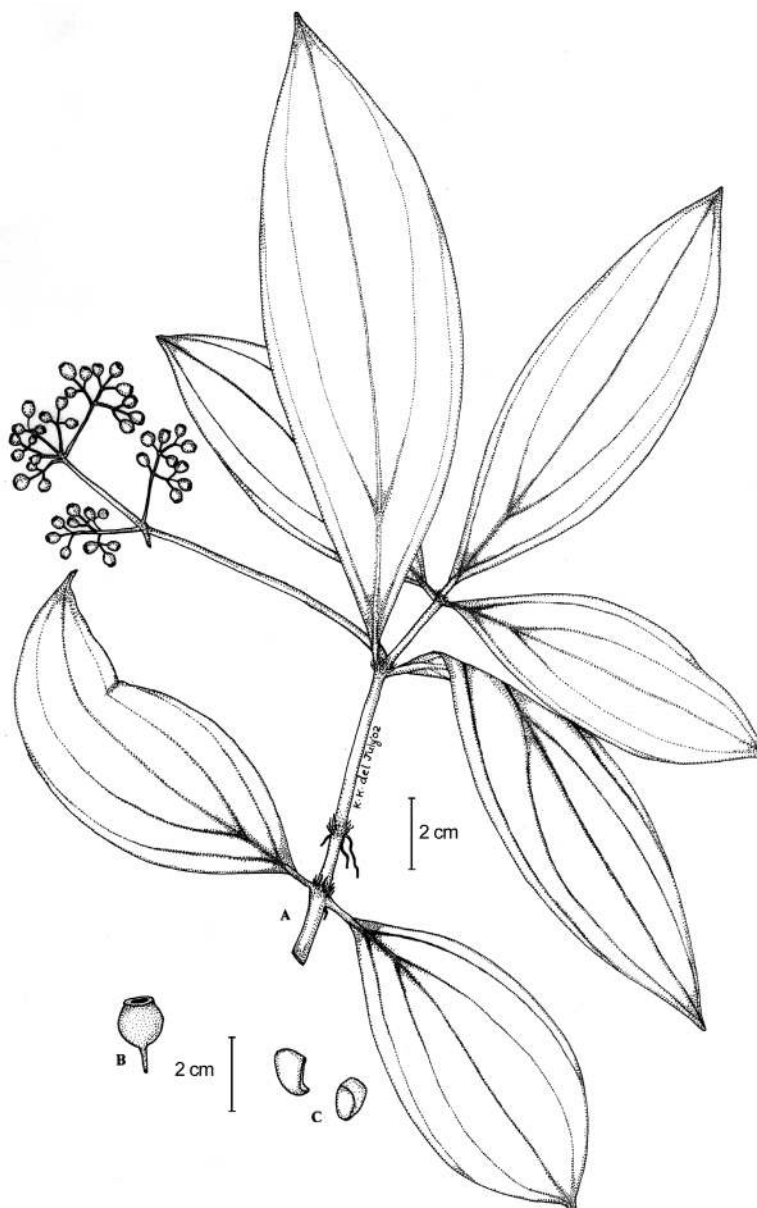


**Fig.1.** : *Medinilla balakrishnanii* Jayanthi, Karthigeyan, Sumathi & Diwakar *sp. nov.* :  
A. Habit; B. L.S. of flower; C. Short and long stamens.

*Etymology* : This species is named after Dr. N.P. Balakrishnan who has greatly contributed to the flora of Andaman and Nicobar Islands.

**2. *Medinilla speciosa*** (Reinw. ex Blume) Blume in H.C. Hall, Bijdr. Nat. Wet. 6:256. 1831; Maxwell in Gard. Bull. Singapore 31:185. 1978; Regalado in Blumea 35:19. 1990. *Melastoma speciosa* Reinw. ex Blume in Flora 14:515. 1831. (**Fig. 2**).

Epiphytic shrub, 2-3 m high. Branches terete to slightly angular, c. 7 mm in diam., glabrous, bark whitish; nodes covered with stiff setaceous bristles. Leaves ternate or quaternate, thickly coriaceous, exstipulate, narrowly to broadly elliptic, 5.5-15 × 2-7 cm, acute-acuminate at apex, entire along margins, cuneate and slightly unequal at base, decurrent to petiole, 5-nerved; nerves raised above and below, slightly winged above; transverse veins faintly visible on lower surface; petioles 0.6-1 cm long. Inflorescences terminal or sometimes axillary penicles of cymes, many-flowered, up to 17 cm long and 7 cm across; rachis and side branches dark pink, quadrangular, winged; peduncles 5-7 cm long, quadrangular, winged, dark pinkish. Bracteoles linear, c. 1 mm long. Flowers not seen. Berries globose, dark pink-purplish, c. 1 cm across; stalk 4-7 mm long, slightly angular. Seeds numerous, embedded in pulpy mass, less than 1 cm long.



**Fig. 2.** *Medinilla speciosa* (Reinw. ex Blume) Blume : A. Habit; B. Fruit; C. Seeds.



*Fl. & Fr.* : May - June.

*Habitat* : Found abundantly in the evergreen forest at an altitude of  $\pm$  600 m.

*Specimen examined* : India, Andaman & Nicobar Islands : Great Nicobar, Mount Thullier, 2 June 2002, J. Jayanthi, R. Sumathi & K. Karthigeyan 19354 (PBL).

*Notes* : *Medinilla speciosa* Blume is known to be distributed in Malay Peninsula, Sumatra, Java, Lesser Sunda Islands, Sulawesi, Moluccas and Borneo (Maxwell, 1978). Occurrence of this species in Great Nicobar extends its range of distribution to India. It is to be noted that the Great Nicobar specimens are smaller when compared to that of Bornean counterpart. This plant could be cultivated as an ornamental for its dense panicle of delicate pink flowers.

#### ACKNOWLEDGEMENTS

The authors are grateful to Dr. M. Sanjappa, Director, BSI for facilities, Dr. P. Lakshminarasimhan, IBLO, RBG, Kew for comparing our specimens at Kew, Dr. J.F. Veldekamp, National Herbarium Nederland, Leiden for his suggestions and the Latin diagnosis, Dr. T. Chakrabarty for going through the manuscript and Dr. P. Dayanandan, Dr. C. Livingstone and Dr. D. Narsimhan, Department of Botany, Madras Christian College for encouragement.

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### ग्रेट निकाबार द्वीप, भारत में मेडिनिला गॉडिच ( मेलासटोमाटेसी ) पर नोट

जे. जयन्ती, के कार्तिग्येन, आर. सुमथी व पी.जी. दिवाकर

#### सार संक्षेप

मेडिनिला कोरिएसिया मेरिल की समवर्गी एक नई जाति अर्थात मेडिनिला बालकृष्णनाई का वर्णन है। भारत के वनस्पति जात में योगदान के रूप में प्रथम बार मेडिनिला स्पेसिओसा (रेनवर्ट एक्स ब्लूम) ब्लूम का विस्तृत, सचित्र वर्णन एवं पारिस्थितिकीय नोट्स प्रस्तुत किए गए हैं।

## ETHNOMEDICINAL PLANTS OF THE ABORIGINES IN ANDAMAN & NICOBAR ISLANDS, INDIA

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### ABSTRACT

The paper deals with ethnomedicinal uses of 289 plant species belonging to 233 genera under 116 families, which include 247 species of angiosperms (198 genera of 87 families), 6 species of gymnosperms (4 genera of 4 families), 35 species of pteridophytes (30 genera of 24 families) and a solitary species of alga used by the aborigines in Andaman & Nicobar Islands. The uses of different plant species by the aborigines are rendered in a tabular form, where plants have been arranged alphabetically with their botanical names, local names, followed by family, habit of plant, plant parts used, names of diseases and tribes.

**Keywords :** Aborigines, Andaman & Nicobar Islands, Ethnomedicinal plants, Diseases, Tribes.

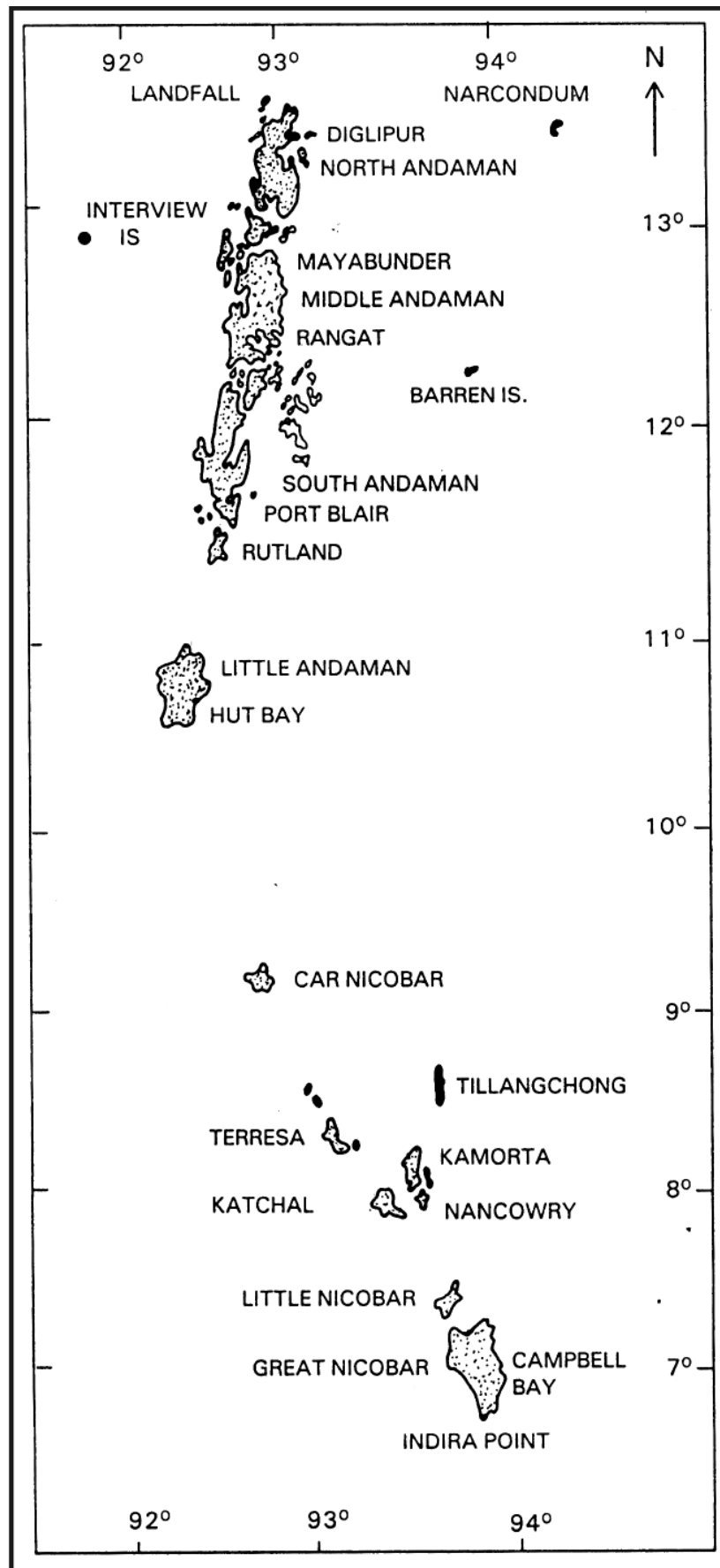
### INTRODUCTION

Traditional healthcare practices of indigenous people pertaining to human health are termed “*Ethnomedicine*”. Ethnomedicine is the mother of all other system of medicines. Medicinal plants provide an efficient local aid to healthcare and disease-free life. Traditional ethnomedicinal studies have in recent years received much attention for their wide local acceptability and rendering clues for new or lesser known medicinal plants (Tripathi, 2000). Over 17,000 species of flowering plants under c. 320 families are reported to occur in India, of which about 9,000 are economically useful. Whereas, 7,500 of these species are reported to be used for healthcare by various ethnic communities in India, 3,900 are reported to be edible, 700 culturally important, 525 used for fibre, 400 for fodder, 300 for pesticide and insecticides, 300 for gums, resins and dyes and 100 provide incense and perfumes. Besides 17,000 flowering plants, the floral diversity also included 64 gymnosperms, 1,200 pteridophytes, 2,850 bryophytes, 13,000 fungi and 12,500 algae. In all, India has about 48,000 floral and 80,000 faunal species (Anonymous, 1994; Arora, 1997). Only about 2,500 plant species of medicinal value have been well documented in Indian system of medicine and under ethnobotany (Jain, 1991). However, some medicinal plants database lists out more than 4,700 species used in Indian system of folk medicine (Anonymous, 1998).

The role of indigenous knowledge in the realm of medicinal plants is noteworthy. Indigenous communities associated with the wild plants of the forests and they nurture rich knowledge about medicinal plants developed over generation by bold experimentation through trial and error methods (Sahi, 2003). The Andaman & Nicobar Islands (**Map 1**), the hotspots of biodiversity, representing a great emporium of ethnobotanical wealth are an abode of six different aboriginal native tribes. In spite of floristic, socio-economical and anthropological interests in these islands, studies on the folk medicinal utilities of plants are limited and meagre (Dagar & Singh, 1999).

The tribes of the Andaman & Nicobar Islands fall under two ethnic groups. The Andaman group of Islands are inhabited by the tribes *Great Andamanese*, *Onges*, *Sentinelese* and *Jarawa* and are of the *Negrito stock*. The population of *Great Andamanese* and *Onges* are dwindling and they have been rehabilitated on the Strait Island and Little Andaman Island respectively. *Sentinelese* occupying the North Sentinel Island, are still hostile. The *Jarawas* inhabit the Jarawa Reserve located along the western parts of the South and Middle Andamans. They have recently become friendly.

The Nicobar group of Islands are inhabited by the tribes the *Nicobarese* and the *Shompens*, belonging to the *Mongoloid stock*. The former are in the mainstream, the latter represent another dwindling tribe. The



Map 1 : Andaman & Nicobar Islands.

Ranchi and Karens are the tribal communities of mainland India and Myanmar respectively. They were brought here for timber extraction work during the British period. They inhabited in the remote areas of Andaman Islands and they have also vast knowledge of medicinal plants. Most of the non-indigenous plants reported here are mainly used by these communities.

The Andaman & Nicobar archipelago consisting of about 350 islands and over 200 islets lies in the Bay of Bengal between 6°-14° N latitudes and 90°- 94° E longitudes. Almost all the islands and islets oriented in north - south directions simulate an arch and stretch over a length of about 912 km. With a total geographical land area of about 8290 sq km, the terrain of most of the islands is hilly with undulating small mountains and narrow valleys. The highest peak in the Andaman groups is Saddle Peak (732 m above m.s.l.) in the North Andaman Islands and in the Nicobar group Mount Thullier (642 m above m.s.l.) in the Great Nicobar Island. There are two volcanic islands, *viz.* Narcondum Island and Barren Island on the eastern side in the Andaman sea. While the volcano of Narcondum Island is inactive, that of the Barren Island is still active, and is the only active volcano in India.

The general climatic condition of the islands is of warm and humid tropics with the temperature ranging between 22°C to 30°C. The islands receive heavy rainfall from both the south-west and north-east monsoons, the former from May to September and the latter from October to December with the average annual rainfall ranging from 3000 to 3800 mm. The cyclonic winds accompanied by thunder and lightning frequent in the islands. January to March show fairly dry weather with scanty rainfall. The mean relative humidity is rather high and usually remains between 82% to 85% throughout the year. All these climatic factors lead to lush green, dense luxuriant and rich phytodiversity in these islands.

The territory, physical isolation between the islands and from the neighbouring continental land masses through millions of years has resulted in the evolution of a rare and distinct flora. The flora shows much closer affinity with Myanmar, Malesian and Indonesian flora. The vegetation comprises tropical evergreen forests, deciduous forests, littoral forests, mangroves forests and open grasslands. The total forest area is about 84.42% of the land area at present (Anonymous, 2005).

Hitherto, nearly 2631 indigenous and non-indigenous vascular plant species are recorded and many of them are either unexploited or under-exploited while a few are over exploited. The tribes of Andaman & Nicobar Islands have very good knowledge of the plants growing around them and in the forests. They are using a number of wild plants for treating various physical ailments. The important medicinal plants and their uses are enumerated in a tabular form (*Table 2*). Plants have been arranged alphabetically with their botanical names, local names (H-Hindi name, N-Nicobarese, O-Onge, GA-Great Andamanese, J-Jarawas, S-Shompens) followed by family name and habit of plant, parts used, diseases and tribes (GA = Great Andamanese; J = Jarawas; O = Onge; N = Nicobarese; S = Shompens; All = all the tribes except Sentinelese; R = Ranchi people; K = Karens (Minor ethnic).

### PREVIOUS WORK

Recently a review paper on the Ethnobotany of the Andaman & Nicobar Islands by Chakraborty & Balakrishnan (2003), wherein they have reviewed the literature and different uses of plants by the aboriginals. They dealt with comprehensive lists of plants and their uses. They listed 21 plant species as ethnomedicinal value for the tribals. Other contributors *viz.* Dagar & Dagar (2003) dealt with plant used by the Nicobarese; Sharief & al., (2005) studied the traditional phytotherapy among Karens and Gupta, & al., (2004) published indigenous knowledge on some medicinal plants among Nicobari tribe of Car Nicobar Island. Very recently Kaushal Kumar, & al., (2006) dealt with 197 plant species used by Nicobarese, out of which 153 species are of medicinal use. The authors undertook the present study to provide up to date knowledge on the ethnomedicinal plants of Andaman & Nicobar Islands aboriginals. Further, the ethnomedicinal uses of plants by the aborigines

dealt in this paper urgently require thorough clinical, chemical, medicinal and pharmaceutical investigations by the modern research laboratories working in this field.

### MATERIALS AND METHODS

The present study is based on more than fifteen botanical explorations in different islands of the region, personal experience of the authors and previous published literature. During the floristic survey contacts were made with several experienced and elderly men, women, forest dwellers, chief of tribal personal and other knowledgeable settlers who are living in contact with aboriginal native tribes. The ethnomedicinal plants data presented in this paper also include earlier published literature on this subject as well as authors own observation made during the plant explorations marked by asterisks (\*). Most of the specimens were collected, identified and deposited in the Herbarium of Botanical Survey of India, Port Blair (PBL). This report is prepared for scientific purposes only. Due to the noxious effects of some plant species, there is possibility of adverse effects from certain uses, which require thorough clinical and pharmaceutical analysis. The authors neither affirm nor deny the efficacy of the medicinal plants.

### RESULTS AND DISCUSSION

The present study comprises ethnomedicinal account of 289 plant species belonging to 116 families and 233 genera, comprising 247 species of Angiosperms (belonging to 198 genera under 87 families), 6 species of gymnosperms (belonging to 4 genera under 4 families), 35 species of pteridophytes belonging to 30 genera under 24 families) and a solitary species of Alga (**Table 1**), which also includes 111 species of trees, 44 shrubs, 36 herbs / undershrubs, 32 climbers / twiners, 35 ferns species, 20 rhizome bearing species, 7 epiphytic, 3 grasses/sedges and a solitary algal species (**Fig.1**). The plants of some families viz. Euphorbiaceae (19 spp.), Moraceae (16 spp.), Apocynaceae (14 spp.), Zingiberaceae (10 spp.), Fabaceae (8 spp.), Convolvulaceae (6 spp.), Verbenaceae (6 spp.) and Rubiaceae (5 spp.) etc. are widely used by the aborigines of Andaman & Nicobar Islands. These eight families also coincide with the ten dominant families in the flora of Andaman & Nicobar islands.

The maximum use of trees (111 spp.) as ethnomedicines by the tribals stand first and it is being followed by shrubs (44 spp.), herbs/undershrubs (36 spp.), ferns (35 spp.), climber (32 spp.), rhizomatous species (20 spp.), epiphytic (7 spp.), grasses / sedges (3 spp.) and a solitary species of algae (**Fig.1**).

*Table.1:* Showing total number of taxa of different plant groups used by the aborigines in A & N Islands.

Sl. no.	Taxa	Families	Genera	Species
1	Angiosperms	87	198	247
2	Gymnosperms	4	4	6
3	Pteridophytes	24	30	35
4	Algae	1	1	1
	Total	116	233	289

### RECOMMENDATIONS

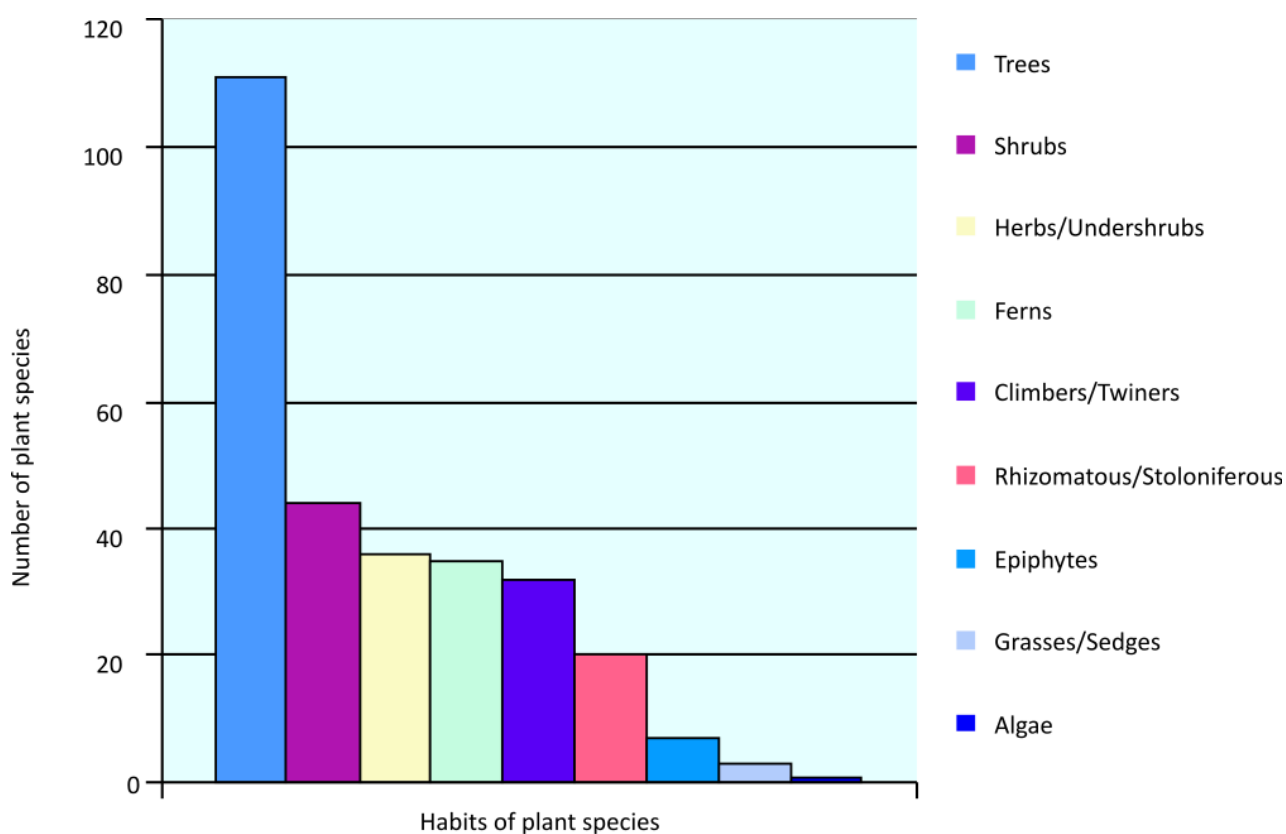
The following are the common plant species extensively used by the different aborigines: *Donax cannaeformis* (G. Forst.) K. Schum., *Alstonia kurzii* Hook. f., *A. macrophylla* Wall. ex G. Don, *Amomum aculeatum* Roxb., *Hornstedtia fenzlii* (Kurz) K. Schum., *Ardisia oxyphylla* Wall. ex DC., *A. solanacea* (Poir.) Roxb., *Asparagus racemosus* Willd., *Byttneria andamanensis* Kurz, *Chromolaena odorata* (L.) King & Robinson, *Calophyllum inophyllum* L., *Claoxylon indicum* (Reinw. ex Blume) Hassk., *Costus*



**Plate 1-6 :** Aborigines of Andaman and Nicobar Islands.

*speciosus* (Koen.) J. E. Sm., *Cyperus rotundus* L., *Ficus* spp., *Exoecaria agallocha* L., *Ganophyllum falcatum* Blume, *Globba marantina* L., *Glochidion calocarpum* Kurz, *Knema andamanica* (Warb.) de Wilde, *Macaranga tanarius* (L.) Muell.- Arg. , *Mallotus peltatus* (Geisel.) Muell.- Arg., *Morinda citrifolia* L., *Myristica andamanica* Hook. f., *Ocimum teuniflorum* L., *Ophiorrhiza nicobarica* N.P. Balakr., *Peperomia pellucida* Kunth, *Phyllanthus emblica* L., *P. debilis* Klein ex Willd., *Piper betle* L., *Pongamia pinnata* (L.) Pierre, *Premna pyramidata* Wall. ex Schauer, *Samanea saman* (Jacq.) Merr., *Scaevola sericea* Forst. f. ex Vahl, *Semecarpus kurzii* Engler, *Sterculia rubiginosa* Vent., *Syzygium samarangense* (Blume) Merr. & Perry, *Tacca leontopetaloides* (L.) O.Kuntze, *Thottea tomentosa* C. Blume) Ding Hou, *Thespesia populnea* (L.) Sol. ex Corr., *Wedelia biflora* (L.) DC., *Zingiber squarrosus* Roxb., *Z. zerumbet* (L.) Rosc. ex J. E. Sm. etc. If some of the above species may scientifically be evaluated and cultivated / planted by the departments viz. Agriculture, Forest, and CARI, it may improve the socio – economic conditions of these islands.





**Fig.1.** Showing habit-wise classification of different plant species used by the aborigines in A & N Islands.

*Table 2:* Showing important medicinal plants used by the tribals of Andaman & Nicobar Islands.

Sl. No.	Name of plant, local name, family & habit	Part of plant used as medicines	Name of Disease/ ailment	Name of Tribe *
1	2	3	4	5
1.	<b>Abelmoschus moschatus</b> Medic. 'Kim-pong' (N) (MALVACEAE) Undershrub	Plant sap and crushed leaves.	Boar and pig bite.	N
2.	<b>Abrus precatorius</b> L. (FABACEAE) Climber	The pounded leaves of this plant and the leaves of <i>Tabernaemontana crispa</i> , with water taken orally.  Leaves and lime are mashed between palms and squeezed to get an extract which is mixed in coconut oil and applied with the help of hen's feather.	Blood discharge in urine.  Burns and blisters of skin.	N  N

\* GA = Great Andamanese, J = Jarawas, N = Nicobarese, O = Ongese, S = Shompens, R = Ranchi People, K = Karens (Minor ethnic) and All = Except Sentinelese.

1	2	3	4	5
3.	<b>Acalypha indica</b> L. – ‘ <i>Kulching</i> ’ (N) (EUPHORBIACEAE) Herb	*Crushed leaves taken orally.	Gastro – intestinal troubles and cuts – wounds.	N
4.	<b>Achyranthes bidentata</b> Blume ‘ <i>Panuko</i> ’ (N) (AMARANTHACEAE) Herb	Root extract taken orally.	Stomach pain.	N
5.	<b>Acorus calamus</b> L. – ‘ <i>Laniti</i> ’ (ARACEAE) Rhizomatous herb	Paste of rhizome along with <i>Piper betel</i> leaves fresh <i>Kaempferia rotunda</i> rhizome, <i>Peperomia pellucida</i> plant and cloves by adding salt or sugar is applied externally on forehead or sometimes all these plants are boiled and vapour is inhaled.	Headache, fever, gastric problems.	All
6.	<b>Adenia penangiana</b> (Wall. ex G. Don) de Wilde – ‘ <i>Tincham</i> ’ (N) (PASSIFLORACEAE) Climber	*Leaves paste rubbed on chest.	Chest pain.	N
7.	<b>Adenostemma lavenia</b> (L.) O. Kuntze ‘ <i>Mi - top</i> ’ (N) (ASTERACEAE) Herb	Pounded leaves applied on affected parts.  Leaves mixed with <i>Ocimum tenuiflorum</i> are crushed in the blood of pig and hen and taken orally.	Chronic chest pain and toothache.  To cure severe pain of breast or chest.	N  N
8.	<b>Aerva lanata</b> (L.) Juss. ex Schult. ‘ <i>Kama - ha - la</i> ’ (N) (AMARANTHACEAE) Herb	*Pounded leaves smeared on body.	Fever.	N
9.	<b>Aganosma marginata</b> (Roxb.) G. Don (APOCYNACEAE) Climber	Decoction of the leaves taken orally.	Urinary troubles & as emmenagogue.	N & S
10.	<b>Ageratum conyzoides</b> L. – ‘ <i>Topinyom</i> ’, <i>So - Pak - re</i> ’ (N), ‘ <i>Aakte</i> ’ (J). (ASTERACEAE) Herb	*Juice of leaves dropped in eyes. Tender shoot tied around neck.	Eye infection.  Fever and throat pain.	N & S  J
11.	<b>Aglaonema simplex</b> Blume var. <b>malaccense</b> Schott. – ‘ <i>Pumroh</i> ’ (N) (ARACEAE) Herb	The pounded leaves in coconut oil, which rubbed on the body of pregnant woman. Leaf juice is taken orally.	To keep baby in normal position.  For painless and easy delivery.	N
12.	<b>Allamanda cathartica</b> L. (APOCYNACEAE) Straggling shrub	Bark and leaves decoction taken orally.	Used as a hydrogogue.	N
13.	<b>Allium cepa</b> L. – ‘ <i>Pyaj</i> ’ (H) (LILIACEAE) Herb	*Bulbs eaten as such.	Blood pressure and as an antidiabetic.	R

1	2	3	4	5
14.	<b>Allium sativum</b> L. – ‘ <i>Lahsun</i> ’ (H) (LILIACEAE) Herb	Bulbs roasted in vegetable oil and also its juice applied externally.	Earache, cold, fever and skin diseases.	R
15.	<b>Alocasia macrorrhizos</b> (L.) G. Don (ARACEAE) Herb	*Plant sap applied externally.	Against scorpion sting.	All
16.	<b>Alpinia manii</b> King ex Baker (ZINGIBERACEAE) Herb	Plant extract smeared on the body.	As bee – repellant.	A, S & N.
17.	<b>Alstonia kurzii</b> Hook. f. ‘ <i>Taungmeok</i> ’ (S) (APOCYNACEAE) Tree	*Extract of leaves, bark and roots taken orally. Plant extract taken orally, also known as “ <i>saptachada</i> ” in Ayurvedic medicine.	Fever and cold – cough. Used in epilepsy, fever and filaria.	N & S N
18.	<b>Alstonia macrophylla</b> Wall. ex G. Don ‘ <i>Tachoroi</i> ’ (S), <i>Chuharoi</i> ’ (N) (APOCYNACEAE) Tree	Extract of leaves & root bark applied externally. Leaf juice in water taken orally. *Leaf paste applied externally on the vaginal area. Bark extract taken orally.	Stomach ache and bone fracture. Painful menstruation. For relief after delivery. As tonic, febrifuge, anthelmintic and galactagogue.	N & S N N N & S
19.	<b>Alstonia scholaris</b> (L.) R.Br. ‘ <i>Chatian</i> ’ (H) (APOCYNACEAE) Tree	Bark extract taken orally. Latex applied externally.	As tonic. On sores, ulcers, tumors and rheumatic swellings.	N N & S
20.	<b>Amomum aculeatum</b> Roxb. ‘ <i>Viyam</i> ’ (J) (ZINGIBERACEAE) Herb	Leaf and stem tied around chest. *Leaf juice applied externally. Fresh plant sap applied on body.	Cough and fever. On scars and scabies.	J J
21.	<b>Ampelocissus barbata</b> (Wall.) Planch. - ‘ <i>Pinuh</i> ’ (VITACEAE) Climber	Fresh leaf - juice dropped in eyes.	Conjunctivitis.	N
22.	<b>Ancistrocladus tectorius</b> (Lour.) Merr. - ‘ <i>Tealpathow</i> ’ (K) (ANCISTROCLADACEAE) Climber	Paste of leaves and stem-bark with <i>Centella asiatica</i> , <i>Schefflera elliptica</i> leaves, <i>Oxalis corniculata</i> plant and <i>Curcuma longa</i> rhizome.	Bone fracture.	K
23.	<b>Annona muricata</b> L. - ‘ <i>Kofi</i> ’ (N) (ANNONACEAE) Small tree	Leaf paste applied externally. *Seeds, powdered.	Skin sores and eruptions. As fish poison.	N N
24.	<b>Annona reticulata</b> L. ‘ <i>Olka</i> , <i>Eang</i> , <i>Alo</i> ’ (N) (ANNONACEAE) Small tree	Leaf paste tied on fractured bones.	Bone fracture.	N



7. *Boesenbergia siphonantha* (King ex Baker) Sabu & al.,



11. *Zingiber squarrosus* Roxb.



8. *Costus speciosus* (Koen.) J. E. Sm.



12. *Momordica cochinchinensis* (Lour.) Spreng.



9. *Thottea tomentosa* (Blume) Ding – Hou



13. *Tabernaemontana crispa* Roxb.



10. *Gnetum gnemon* L.



14. *Hibiscus tiliaceus* L.

1	2	3	4	5
25.	<b>Anodendron paniculatum</b> (Roxb.) DC. 'Pharako' (GA) (APOCYNACEAE) Climber	Raw leaves eaten by pregnant women. The watery - milky juice of the plant applied externally.	To cause abortion. Said to be antiseptic	GA, N & S GA
26.	<b>Antidesma coriaceum</b> Tul. 'Ray' (GA), 'Niyat', 'Miyoto' (N) (EUPHORBIACEAE) Tree	Paste, juice and vapours obtained from chewing the leaves are sprayed by mouth on honey bees to disperse them during honey collection. Decoction taken orally.	As honey bees - repellent. To cure acute cough and cold.	GA N
27.	<b>Aporosa villosa</b> (Lindl.) Baill. (EUPHORBIACEAE) Tree	*Leaf juice taken orally and rubbed on the body of ladies.	To increase fertility.	N
28.	<b>Ardisia oxyphylla</b> Wall. ex DC. 'Mikuhon' (N) (MYRSINACEAE) Small tree	Decoction of leaves taken orally. *Pounded leaf paste boiled in water taken by both husband and wife, who are not having child.	To increase fertility. To achieve early pregnancy.	N N
29.	<b>Ardisia solanaceae</b> (Poir.) Roxb. 'Minkuon', 'Chafum' (N), 'Khari Phall' (H) (MYRSINACEAE) Shrub	*Paste of leaves smeared. *Crushed leaves infusion in water in water taken orally. Roots boiled in water.	Mumps. To check abortion and menses disorder. The extract used for washing uterus after delivery and wounds - an antiseptic.	N N S & N
30.	<b>Areca triandra</b> Roxb. 'Kah Koh' (N), 'Jungli - supari' (H) (ARECACEAE) Tree	*Endosperm chewed with <i>Piper betel</i> leaf.	As mouth freshener and stomachic.	N
31.	<b>Argemone mexicana</b> L. 'Satyanashi' (N) (PAPAVERACEAE) Undershrub	Yellow sap of stem and branches. *Yellow plant juice taken orally.	In conjunctivitis. To cure dropsy, jaundice, cutaneous affection, diuretic, relieve blisters, heals excoriations and ulcers.	N N, S & J
32.	<b>Argyrea hookeri</b> C. B. Clarke 'Bilikhu' (GA) (CONVOLVULACEAE) Climber	Extract of leaves applied externally.	Hydrocele.	GA
33.	<b>Aristolochia tagala</b> Cham. 'Mincho - Koyen, Punkot' (N) (ARISTOLOCHIACEAE) Climber	*Decoction of leaves. Pounded leaves warmed and mixed with hen's blood pasted on stomach around naval.	Gynecological problems. To cure abdominal - chest pain and stomachache.	N N





15. *Pongamia pinnata* (L.) Pierre



19. *Sterculia rubiginosa* Vent.



16. *Myristica andamanica* Hook. f.



20. *Pandanus leram* Jones ex Fontane



17. *Glycosmis mauritiana* (Lam.) Tanaka.



21. *Ipomoea pes-caprae* (L.) R. Br. spp. *brasiliensis* (L.) Ooststr.



18. *Leea aequata* L.



22. *Canavalia cathartica* Thou.





23. *Gloriosa superba* L.



27. *Morinda citrifolia* L. in flowering



24. *Hornstedtia fenzlii* (Kurz) K. Schum.



28. *Scaevola sericea* Forst. f. ex Vahl



25. *Orophea katschallica* Kurz



29. *Tacca leontopetaloides* (L.) O. Kuntze



26. *Morinda citrifolia* L. in fruiting



30. *Thespesia populnea* (L.) Sol. ex Corr.

1	2	3	4	5
34.	<b>Artocarpus communis</b> J. R. Forst. & G. Forst. – ‘ <i>Pompu</i> ’ (N), ‘ <i>Bilaiti kathal</i> ’ (H) (MORACEAE) Tree	*Milky latex used externally.	Head wounds, ulcers and abscesses.	N & S
35.	<b>Artocarpus heterophyllus</b> Lamk. ‘ <i>Kathal</i> ’, ‘ <i>Tokavoko</i> ’ (N) (MORACEAE) Tree	Milky latex applied externally.	On swellings, abscesses and wounds.	N & O
36.	<b>Artocarpus lakoocha</b> Roxb. ‘ <i>Barhal</i> ’ (H) (MORACEAE) Tree	*Powdery bark applied externally.	Cure pimples, crakes and sores.	N & S
37.	<b>Asparagus racemosus</b> Willd. ‘ <i>Kanyoplur, Kanyammur</i> ’ (K) (LILIACEAE) Climber	Paste of fresh root with sugar and water. *Roots paste applied externally.	Jaundice. As cooling agent and as appetizer.	K J & O
38.	<b>Baccaurea ramiflora</b> Lour. ‘ <i>Kachchmai</i> ’ (N), ‘ <i>Khatta – Phal</i> ’ (H) (EUPHORBIACEAE) Small tree	Leaf paste applied externally. *Seeds powder.	To cure cuts and wounds. As fish poison.	N N
39.	<b>Basella alba</b> L. – ‘ <i>Poi</i> ’ (H) (BASELLACEAE) Climber	Leaves extract, taken orally.	Against constipation.	O
40.	<b>Belamcanda chinensis</b> (L.) DC. (IRIDACEAE) Herb	Rhizome powder taken orally.	In cough.	H & O
41.	<b>Bixa orellana</b> L. – ‘ <i>Akvel</i> ’ (N) (BIXACEAE) Shrub	Plant sap and resin used externally.	To cure skin diseases.	N
42.	<b>Blumea balsamifera</b> (L.) DC. ‘ <i>Hotlik</i> ’ (N) (ASTERACEAE) Undershrub	Pounded leaves.	Chest pain and to increase appetite.	N
43.	<b>Boesenbergia siphonantha</b> (King ex Baker) Sabu & al. ‘ <i>Suu, Chu</i> ’ (K) (ZINGIBERACEAE) Rhizomatous herb	Fresh rhizome paste and a pinch of salt and water taken orally. *Tuber powder applied externally.	Gastric and Giddiness. Mumps.	K J & O
44.	<b>Breynia racemosa</b> (Blume) Muell. - Arg. – ‘ <i>Fanot, Pitcong, Teong</i> ’ (N) (EUPHORBIACEAE) Shrub	Macerated leaves and leaf juice in water taken orally.	Swellings, skin diseases body pain, as febrifuge and in swollen testicles.	N & J
45.	<b>Bridelia tomentosa</b> Blume ‘ <i>Ka - noh, Ranam</i> ’ (N) (EUPHORBIACEAE) Small tree	Leaf decoction taken orally. Fruits eaten as such.	Dysentery. As health tonic.	N N
46.	<b>Byttneria andamanensis</b> Kurz ‘ <i>Lafech</i> ’ (N) (STERCULIACEAE) Climber	Aqueous extract of leaves taken orally by ladies.	For painless delivery.	J, O & GA
47.	<b>Caesalpinia bonduc</b> (L.) Roxb. <i>emend</i> Dandy & Exell. – ‘ <i>Va-Knuato</i> ’ (N) (CAESALPINIACEAE) Scandent shrub	Paste of leaves mixed with coconut oil. Leaf paste of this plant with the leaf of <i>Crinum asiaticum</i> and <i>Heritiera littoralis</i> is mixed in coconut oil.	Fever and body pain. To check early discharge.	J & O J & O

1	2	3	4	5
		*Dry seed powder tied on swollen testicles.	Hydrocele.	N
		Seeds mixed with hen's egg albumen are applied on swollen testicles.	To cure hydrocele.	N & R
48.	<b>Calamus viminalis</b> Willd. 'Ma - nya, Kin - vi - ti' (O) (ARECACEAE) Climber	Leaves are being used as a covering on genital parts (bul).	As genital covering and antiseptic.	O
49.	<b>Callicarpa longifolia</b> Lam. 'Kinvi - taong' (N) (VERBENACEAE) Shrub	Paste of leaves applied externally.	For cuts, wounds and bone fractures.	N
		Leaves are made into paste mixed with pig fat and applied externally.	To cure severe cuts and fever.	N
50.	<b>Calophyllum inophyllum</b> L. 'Intanng, Lamonk, Inyang' (N) (CLUSIACEAE) Tree	*Latex from branches and leaves.	Eye infection and bone fracture and killing lice.	N
51.	<b>Calotropis gigantea</b> (L.) R. Br. 'Madar, 'Safed akvan' (N) (ASCLEPIADACEAE) Shrub	Milky latex applied externally.	To cure ulcers, wounds and sores.	N
52.	<b>Calotropis procera</b> (Ait.) R. Br. 'Madar' (N) (ASCLEPIADACEAE) Shrub	*Milky latex used externally.	To cure skin diseases and old wounds.	N & O
53.	<b>Camellia sinensis</b> (L.) O. Kuntze 'Chaye patti' (K) (THEACEAE) Tree	Leaf paste applied externally.	Centipede bite and scorpion sting.	K
54.	<b>Canna indica</b> L. - 'Sudharsan' (H) (CANNACEAE) Herb	Rhizome extract, taken orally.	Fever.	N, O & S
55.	<b>Canarium euphyllum</b> Kurz 'Dhup' (O & H) (BURSERACEAE) Tree	*Fumes of the resin.	As mosquito repellent.	O & N
56.	<b>Canavalia cathartica</b> Thou. 'Minuhaeh, Burma same' (K) (FABACEAE) Climber	Leaf extract taken orally.	Fever.	N
		Grounded seeds powder with rice kanji (gruel) and sugar taken orally.	Skin diseases.	K
57.	<b>Carica papaya</b> L. - 'Papita' (H, GA), 'Papaya' (Eng.) (CARICACEAE) Tree	Dried crushed leaves	Substitute in cigars.	GA
		Bark extract taken orally.	Urinary diseases.	N
		Milky juice of unripe fruits applied externally.	To treat eczema, ringworm, wounds, malignant tumors and bleedings hemorrhoids.	N & S
		Milky latex with sugar taken orally.	Enlarged liver, spleen and whopping cough.	All

1	2	3	4	5
58.	<b>Casearia grewiaefolia</b> Vent. var. <b>gelonoides</b> (Blume) Sleumer 'Kul – tuong', 'Kill tuong' (N) (FLACOURTIACEAE) Tree	Paste of leaves mixed with tamarind leaves and water.	Dysentery.	N
59.	<b>Catharanthus roseus</b> (L.) G. Don 'Sa – dabahar' (N) (APOCYNACEAE) Herb	*Leaves juice dropped in eyes.	Eye infection.	N
60.	<b>Ceiba pentandra</b> (L.) Gaertn. 'Tusa' (N) (BOMBACACEAE) Tree	Seeds powder taken orally.	As health tonic.	N
61.	<b>Celosia argentea</b> L. – 'Motiyn' (N) (AMARANTHACEAE) Herb	Pounded leaves with lime.	Cuts and wounds.	N
62.	<b>Centotheca lappacea</b> (L.) Desv. 'Kunhiol' (N)(POACEAE) Grass	Decoction of rhizome taken orally.	Rheumatic pains.	N
63.	<b>Chisocheton longistipitatus</b> (F. M. Bolay) L. S. Sm. – 'Kinya' (N) (MELIACEAE) Tree	Bark powder applied externally.	Sores, cuts and wounds.	N
64.	<b>Chromolaena odoratum</b> (L.) King & Robinson – 'Tukukala' (O), 'Chalechechmo' (GA), 'Euhben' (N) (ASTERACEAE) Herb	Paste of leaves and twigs with <i>Solanum</i> <i>torvum</i> and lime water applied externally. *Leaves extract.	Cuts and wounds.  Cuts & wounds and in Leech – bite.	K  J, O, N & GA
		Leaves are pounded up by hand and applied on fresh wounds to stop bleeding.	To cure wounds.	All
65.	<b>Citrus medica</b> L. - 'Miyaye' (GA), 'Limong' (N) (RUTACEAE) Shrub	Fruits juice taken orally.	To cure constipation.	GA & N
66.	<b>Claoxylon indicum</b> (Reinw. ex Blume) Hassk. – 'Sing – ke – ra', <i>Hingkuwai</i> (N) (EUPHORBIACEAE) Tree	Paste of leaves applied externally. Leaves mixed in coconut oil and applied by hen's feather.	Pyorrhoea, cuts, wounds and head - ache. To cure sores pimples and fever.	N N
67.	<b>Clerodendrum inerme</b> (L.) Gaertn. 'Mannyi' (N)(VERBENACEAE) Shrub	Pounded leaves and root-bark of <i>Morinda</i> <i>citrifolia</i> .	Joint pains and bone fracture.	N
68.	<b>Clerodendrum nutans</b> Jack. 'Chamhar' (R), 'Manjayay' (N) (VERBENACEAE) Shrub	Stem - bark powder with water taken orally.	Malarial fever, headache and cold – cough.	Ranchi local inhabitants.
69.	<b>Clerodendrum paniculatum</b> L. 'Tang – Vong, Yamon, Kalahoy' (N) (VERBENACEAE) Shrub	Ladies used leaf – decoction orally. Leaves paste used externally.	As abortifacient.  For washing ulcers and sores.	N N
70.	<b>Cocos nucifera</b> L. 'Taoko, Naria, Dob' (N, H) (ARECACEAE) Tree	Coconut oil is rubbed on the body of baby and woman after delivery and also used in several preparations. Pericarp fumes.	As a health tonic.  As mosquito – repellent.	O, N & S N

1	2	3	4	5
71.	<b>Codiocarpus andamanicus</b> (Kurz) Howard (ICACINACEAE) Tree	Warm pounded leaves in coconut oil tied on enlarged scrotum of children.	Pains and swelling of scrotum.	N
72.	<b>Colocasia esculenta</b> (L.) Schott. 'Tahangen, Ghuiyan, Kamum' (N), 'Arvi' (H) (ARACEAE) Tuberous herb	Leaves extract. *Paste of leaves applied externally.	As abortifacient. For chest pain and bone fracture.	J & O N, S, O & J
73.	<b>Colubrina asiatica</b> (L.) Brongn. (RHAMNACEAE) Stragling shrub	Fresh leaf juice of this plant and that of <i>Ochrosia oppositifolia</i> is taken with water.	As emmenagogue.	N
74.	<b>Cordia grandis</b> Roxb. 'Minyap, Matka' (N) (CORDIACEAE) Tree	Paste of leaves mixed with <i>Sterculia rubiginosa</i> leaves.	Stomachache.	N
75.	<b>Costus speciosus</b> (Koen.) J. E. Sm. 'Kewa' (N) (COSTACEAE) Rhizomatous herb	Leaves paste applied externally. Rhizome decoction. Rhizome paste is applied all over the body & decoction of rhizome taken orally.	Stomach disorder. Body pain. Snake – bite, for chicken pox & to cure urinary infection.	N N, O & S All
76.	<b>Crateva religiosa</b> Forst. f. 'Holapoh' (N) (CAPPARACEAE) Tree	Pounded leaves mixed with coconut oil, used externally.	Rheumatic pain.	N
77.	<b>Crinum asiaticum</b> L. 'Sudershan' (J) (AMARYLLIDACEAE) Rhizomatous herb	*Juice of leaves and bulbs.	Cuts, wounds and urinary troubles.	J, O, N & S
78.	<b>Crinum latifolium</b> L. (AMARYLLIDACEAE) Rhizomatous herb	Leaf juice dropped in the ears.	Earache.	O & S
79.	<b>Crotalaria pallida</b> Ait. 'Kulching' (N), 'Uhutesimil' (K) (FABACEAE) Shrub	Leaf extract taken orally. Leaf paste, applied externally.	Stomach pain. Centipede bite and snake bite.	K N,S & J
80.	<b>Croton argyratus</b> Blume 'Mintunah' (N) (EUPHORBIACEAE) Tree	Leaf juice. Seeds powder.	Beverages and body pain. Stomach – disorders.	N S & N
81.	<b>Curculigo orchoides</b> Gaertn. (HYPOXIDACEAE) Rhizomatous herb	Rhizome extract, taken orally.	Jaundice.	N & S
82.	<b>Curcuma longa</b> L. – 'Toiyakoo' (K) (ZINGIBERACEAE) Rhizomatous herb	Paste of fresh rhizome and <i>Schefflera elliptica</i> leaves, banana fruits, eggs and honey applied externally. Rhizome powder used externally.	Bone fracture. Wounds and cuts.	K N & S

1	2	3	4	5
83.	<b>Curcuma zedoaria</b> (Christm.) Rose. (ZINGIBERACEAE) Rhizomatous herb	Rhizome extract, taken orally.	Cooling agent.	O
84.	<b>Cyathostemma viridiflorum</b> Griff. (ANNONACEAE) (Climber)	Pounded leaf paste in water taken orally.  Fresh plant juice smeared on the belly.	As emmenagogue to check excessive bleeding. As an abortifacient.	N  N
85.	<b>Cymbidium alofolium</b> (L.) Sw. 'Titolini' (K) (ORCHIDACEAE)–Epiphyte	Plant extract put into ears with the help of hen's feathers.	Ear pain.	K
86.	<b>Cyperus rotundus</b> L. (CYPERACEAE) Sedge	Tubers eaten as such.	Bowel or intestinal ulcers complaints and as an aphrodisiac.	N, O & S
87.	<b>Daemonorops manii</b> Becc. & Hook. f. 'Tamoyen, Tomonje' (O) (ARECACEAE) Climber	Crushed vegetative shoot apex.	As mosquito repellent.	O
88.	<b>Datura metel</b> L. – 'Kata – kul' (N) (SOLANACEAE) Undershrub	Leaf – paste applied externally.	Snake – bite.	N
89.	<b>Daucus carota</b> L. – 'Gajar' (H) (APIACEAE) Tuberous herb	*Tuberous roots eaten as such.	As health tonic.	R
90.	<b>Desmodium gangeticum</b> (L.) DC. (FABACEAE) Shrub	Crushed juice of the plant, taken orally.	As antivenom.	N & S
91.	<b>Desmodium laxiflorum</b> DC. 'Damle' (O) (FABACEAE) Herb	Chewing of leaves.	Fever.	O
92.	<b>Dillenia pentagyna</b> Roxb. (DILLENIACEAE) Tree	Leaf extract in water taken orally.	For healing wounds and post natal wounds.	N
93.	<b>Dioscorea alata</b> L. (DIOSCOREACEAE) Climber	Plant extract in water taken orally.	Piles and leprosy.	J & O
94.	<b>Dioscorea bulbifera</b> L. 'Lai – Long' (N) (DIOSCOREACEAE) Climber	Plant extract along with tubers, taken orally.	Piles & ulcers.	J & O
95.	<b>Dioscorea esculenta</b> (Lour.) Burk. 'Lai – Long' (N) (DIOSCOREACEAE) Climber	*Plant paste applied externally.	Against swellings.	J & O
96.	<b>Dioscorea glabra</b> Roxb. (DIOSCOREACEAE) Climber	Leaf decoction taken orally by ladies. Roasted tubers eaten after delivery.	As contraceptive.  To regain vigour and health.	O  All
97.	<b>Dioscorea pentaphylla</b> L. (DIOSCOREACEAE) Climber	Plant paste applied externally. Leaf decoction taken orally.	Swellings.  As contraceptive.	J & O  O
98.	<b>Diospyros undulata</b> Wall. ex G. Don 'Lintoh' (N) (EBENACEAE) Tree	Leaf extract taken orally. Leaf – paste warm and applied externally.	Fever. Back pain.	N & O N



1	2	3	4	5
99.	<b>Dischidia benghalensis</b> Coleb. 'Talima' (N) (ASCLEPIADACEAE) Epiphytes	Pounded twig paste tied externally.	Bone fracture.	S
100.	<b>Dischidia major</b> (Vahl) Merr. (ASCLEPIADACEAE) Epiphytes	Leaves juice is dropped in ear. Root juice, taken orally.	Earache. Cough & Cold.	N N & S
101.	<b>Donax cannaeformis</b> (G. Forst.) K. Schum. - 'Kagle' (O), 'Leethir' (GA), 'Amok' (N) (MARANTACEAE) Shrub	Extract of leaves. Rhizome extract. *Leaf decoction taken orally.  Pregnant woman also takes before and after delivery. Leaves pounded in coconut oil and pigs blood are smeared on the body. Leaves are placed in drinking water.	Abdominal and spinal pains. Malarial fever. To check Gynaecological disorders particularly pre and postnatal periods. For pre and postnatal periods diseases. To regain appetite. To purify, preserve and cool the water.	O N, O & S O  N N GA
102.	<b>Dracaena angustifolia</b> Roxb. 'Zibak' (O), 'Tidba' (J) (AGAVACEAE) Tree	Leaf juice, taken orally.  Tender twigs as brush.	Stomachache.  For cleaning genitals and wiping menstrual cycle blood.	O & N  J
103.	<b>Dracaena brachyphylla</b> Kurz (AGAVACEAE) Shrub	Leaf juice, taken orally. Tender twigs as brush.	Stomachache. For cleaning genitals and wiping menstrual cycle blood.	O & N J
104.	<b>Dracaena pachyphylla</b> Kurz (AGAVACEAE) Shrub	Leaf juice, taken orally. Tender twigs as brush.	Stomachache. For cleaning genitals and wiping menstrual cycle blood.	O, N & J J
105.	<b>Elaeocarpus tuberculatus</b> Roxb. 'Minrel' (N) (ELAEOCARPACEAE) Tree	Leaf juice in water taken orally.	Urinary troubles.	N
106.	<b>Eria bractescens</b> Lindl. var. <b>affinis</b> (Griff.) Hook. f. (ORCHIDACEAE) Epiphytic orchid	Infusion of leaves, taken orally.	Malarial fever.	N
107.	<b>Erythrina variegata</b> L. - 'Laro' (GA), 'Dandap, Mandara' (H) (FABACEAE) Tree	Bark boiled in tea and taken orally.	To cure fever.	GA
108.	<b>Eulophia nicobarica</b> N.P. Balakr. & N. G. Nair (ORCHIDACEAE) Terrestrial orchid	Tubers extract smeared as well as taken orally.	Tumours and glands in the neck.	N

1	2	3	4	5
109.	<b>Euonymus javanicus</b> Blume (CELASTRACEAE) Tree	Leaf juice in water, taken orally.	Spermatorrhoea.	N
110.	<b>Euphorbia atoto</b> Forst. f. 'Mu-pet' (N) (EUPHORBIACEAE) Herb	Pounded leaves, applied externally.  Plant paste in water taken orally.	Skin diseases, rheumatic pain, ulcers, wounds—cuts and sores.  For reconditioning of belly after child birth.	N  N
111.	<b>Euphorbia hirta</b> L. 'Raihipot' (N), 'Dudhi' (H) (EUPHORBIACEAE) Herb	Pounded leaves used externally. Plants burnt along with hen's feathers into ashes and mixed with coconut oil and applied on the body of child. Milky latex applied externally.	Skin infections.  To cure fever.  To cure wounds and warts.	N  N  N
112.	<b>Euphorbia thymifolia</b> L. – 'Dudhi' (H) (EUPHORBIACEAE) Herb	*Latex applied externally.	To cure warts.	N, S & O
113.	<b>Excoecaria agallocha</b> L. 'Blinding tree' (Eng.) (EUPHORBIACEAE) Tree	Latex with coconut oil taken orally.	As purgative, emetic, abortifacient and also as fish poison.	N & S
114.	<b>Ficus andamanica</b> Corner 'Rengo' (GA) (MORACEAE) Tree	Aerial roots tied on the point of bone fracture.	To have a mending effect, cure is claimed within one night.	GA
115.	<b>Ficus benghalensis</b> L. 'Bar, Bargad' (O & N) (MORACEAE) Tree	*Milky latex applied externally.	To cure rheumatism and lumbago pains.	O & N
116.	<b>Ficus benjamina</b> L.—'Pakur' (O & N) (MORACEAE) Tree	Milky juice dropped in eye.	For eye diseases and whitening of the cornea.	O & N
117.	<b>Ficus hispida</b> L.—'Katgularia' (O), 'Matiyal' (N) (MORACEAE) Tree	*Fresh aerial roots crushed and made into a paste applied externally.	To cure paralytic parts of the patient.	S, N & O
118.	<b>Ficus microcarpa</b> L. – 'Kamrup' (H) (MORACEAE) Tree	Plant juice taken orally.	To cure enlarged liver and other related diseases.	S & N
119.	<b>Ficus racemosa</b> L.—'Gular' (J & O), 'Amrakha' (N) (MORACEAE) Tree	Leaf decoction taken orally. Milky latex taken orally.	To cure fever.  Bleeding piles and diarrhoea.	N & J  N & S
120.	<b>Ficus religiosa</b> L.—'Pipal' (N & O) (MORACEAE) Tree	Latex applied externally.	To cure wounds and sores.	N & O
121.	<b>Ficus rumphii</b> Blume 'Pakar' (J & N) (MORACEAE) Tree	*The milky latex with turmeric, pepper and pure cow's ghee taken orally.  Leaves boiled in coconut oil rubbed on the abdomen of the woman having perpetual bleeding.	To kill intestinal worms and to cure asthma.  To check bleeding.	J & N  N

1	2	3	4	5
122.	<b>Ficus tinctoria</b> Forst. f. (MORACEAE) Tree	*The root-bark powder with water taken orally. Leaf juice taken orally.	As stomachic. Dysuria.	S & J N
123.	<b>Ganophyllum falcatum</b> Blume (SAPINDACEAE) Tree	The leaves of this plant and of <i>Lepisanthes rubiginosa</i> are pounded and squashed in water taken orally.	As contraceptive.	N
124.	<b>Garcinia nervosa</b> Miq. – ‘ <i>Kintul</i> ’ (N) (CLUSIACEAE) Tree	Leaf – decoction taken orally.	Fever.	N
125. & S	<b>Garuga pinnata</b> Roxb. – ‘ <i>Ghogar</i> ’ (N & S) (BURSERACEAE) Tree	Leaf – decoction taken orally.	Plant sap with honey	Asthma. N
126.	<b>Genianthus laurifolius</b> (Roxb.) Hook. f. (ASCLEPIADACEAE) Climber	Leaf extract in water taken orally.	Urinary obstruction.	N
127.	<b>Geodorum densiflorum</b> (Lam.) Schltr. (ORCHIDACEAE) Terrestrial Orchid	Tubers eaten as such by the domestic animals.	As veterinary medicine.	O & S
128.	<b>Globba marantina</b> L. – ‘ <i>Rosukedar</i> ’ (N) (ZINGIBERACEAE) Rhizomatous Herb	Leaves juice dropped in eyes. Rhizome extract, taken. orally.	Cure eye infections Asthma.	N N, S, O & J
129.	<b>Glochidion calocarpum</b> Kurz ‘ <i>Hintiv</i> ’ (N) (EUPHORBIACEAE) Tree	Pounded bark and seeds applied externally. Paste of leaves. Leaves decoction, taken orally.	Skin diseases Cuts and wounds. Fever.	S & N S & N N
130.	<b>Gloriosa superba</b> L. ‘ <i>Kalihari</i> ’ (H) (LILIACEAE) Tuberous climber	*Tubers paste applied externally.	As abortifacient.	J & O
131.	<b>Glycosmis mauritiana</b> (Lam.) Tanaka var. <i>insularis</i> (Kurz) Tanaka ‘ <i>Kuy – anvo</i> ’ (O) (RUTACEAE) Tree	Pounded leaves applied externally.	Chronic headache.	O & N
132.	<b>Grewia acuminata</b> A. L. Juss. (TILIACEAE) Shrub	Fresh decoction of leaves taken orally.	For relieving post-natal pains and swollen abdomen and cleaning parturition waste after delivery.	N
133.	<b>Guettarda speciosa</b> L. ‘ <i>Tu-ma-halus</i> ’ (N) (RUBIACEAE) Tree	Leaf – juice taken orally.	As carminative.	N
134.	<b>Heliotropium indicum</b> L. ‘ <i>Achmoot</i> ’ (N) (BORAGINACEAE) Herb	Crushed leaves with coconut oil, applied externally.	Chest pain in heart troubles.	N
135.	<b>Hedyotis biflora</b> (L.) Lam. ‘ <i>Infech</i> ’ (N) (RUBIACEAE) Herb	Whole plant, used as such. Leaves warm in coconut oil and hen’s blood and applied on the body.	Malarial fever, body pain and cuts and wounds. To cure malarial fever, bodyache, etc.	N N

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136.	<b>Heritiera littoralis</b> Dryand ex W. Ait. 'Moro' (O), 'Sundri' (H), 'Kamreout' (N) (STERCULIACEAE) Tree	*Boiled leaves. Leaf paste of this plant with the leaves of <i>Caesalpinia bonduc</i> and <i>Crinum asiaticum</i> is mixed in coconut oil and rubbed before sexual intercourse by both sexes.	As beverage. To delay discharge, also used in headache and body pains.	O N
137.	<b>Hernandia peltata</b> Meissn. 'Minhont' (N) (HERNANDIACEAE) Tree	Paste of leaves used externally.	Curing headache, cut, wounds, sores and ulcers.	N
138.	<b>Hedychium coronarium</b> Koen. (ZINGIBERACEAE) Rhizomatous herb	Rhizome paste applied externally.	Against rheumatic pains.	R
139.	<b>Hibiscus tiliaceus</b> L. – 'To-u-Ku' (N), 'Koibo' (O), 'Bole' (GA) (MALVACEAE) Tree	Extract of leaves, taken orally. Boiled leaves taken orally. Fresh leaf juice taken orally. Mature leaves extract taken orally.	Urinary infections. As beverage (Tea). In bleeding discharge in urine. Used for stomach disorders. Prepare tea also from mature leaves.	N O N GA
140.	<b>Homalomena cordata</b> Schott. 'Laman' (N) (ARACEAE) Rhizomatous herb	Tubers paste applied externally. Fresh leaves extract taken orally.	Skin diseases. Diarrhoea.	N & S N
141.	<b>Homonium riparia</b> Lour. (EUPHORBIACEAE) Shrub	Milky latex applied externally.	To heal wounds and sores.	N
142.	<b>Hornstedtia fenzlii</b> (Kurz) K. Schum (ZINGIBERACEAE) Herb	Rhizome extract taken orally. Paste of stem, leaves and flowers applied externally.	Malarial fever. Bee-repellant.	N & S N & S
143.	<b>Horsfieldia glabra</b> (Blume) Warb. 'Jugane' (O) (MYRISTICACEAE) Tree	Raw fruits eaten as such.	Abdominal pain.	O
144.	<b>Ichnocarpus volubilis</b> (Lour.) Merr. (APOCYNACEAE) Climber	Crushed leaves in water taken orally.	Menstrual disorder.	N
145.	<b>Ipomoea aquatica</b> Forssk. 'Kalmi sag' (H) (CONVOLVULACEAE) Aquatic stoloniferous herb	Fresh plant juice taken orally.	To reduce opium and Arsenial poisoning and as emetic.	S & N
146.	<b>Ipomoea batata</b> Lam. 'Sakar kand' (H) (CONVOLVULACEAE) Tuberous herb	Tubers eaten as such to regain vigour.	As health tonic.	R
147.	<b>Ipomoea pes-caprae</b> (L.) R. Br. spp. <b>brasiliensis</b> (L.) Ooststr.	Paste of leaves applied externally.	Headache and for easy delivery.	N

1	2	3	4	5
	'Lanankap' (N), 'Dopatilata' (S) (CONVOLVULACEAE) Stoloniferous herb	Leaf extract in water taken orally. The juice of plant applied externally.  Dried juice taken orally.	For easy delivery and Stomach disorder. For skin diseases and bites and stings of fishes. As purgative.	N  N  S & N
148.	<b>Ipomoea quamoclit</b> L. – 'Kamalata' (H) (CONVOLVULACEAE) Twiner	Fresh plant juice with hot ghee is taken orally.	Bleeding piles.	N
149.	<b>Ixora brunnescens</b> Kurz 'Hama - ok' (N) (RUBIACEAE) Tree	Pounded leaves applied externally. Pounded leaves with hen's blood and applied on forehead.	Headache. Headache.	N N
150.	<b>Jasminum syringifolium</b> Wall. ex G.Don (OLEACEAE) Climber	Pounded leaves of this plant with the leaves of <i>Genianthus laurifolius</i> and <i>Sterculia rubiginosa</i> in water taken orally.	Obstruction of urine.	N
151.	<b>Jatropha curcas</b> L. 'Bagherend' (H) (EUPHORBIACEAE) Shrub	Plant juice applied externally. *Tender branches.	Scabies, eczema and ringworms. As tooth brush to relieve pain from swollen gums and teeth.	N & S O & J
152.	<b>Knema andamanica</b> (Warb.) de Wilde 'Oro, Aurue' (J) (MYRISTICACEAE) Tree	Bark and leaves paste applied externally.	On wounds and cuts.	J
153.	<b>Leea aequata</b> L. (LEEACEAE) Shrub	Paste of leaves with pig oil applied externally.	On wounds. A stick of the plant is also used for killing the snakes and it is believed that snake remains away from this plant.	N
154.	<b>Leea angulata</b> Korth ex Miq. 'Kototo' (N) (LEEACEAE) Shrub	Paste of leaves mixed with pig oil, applied externally.	Antiseptic for wounds.	N
155.	<b>Leea indica</b> (Burm. f.) Merr. 'To- kitinyu, Kurkur – jiwah' (N) (LEEACEAE) Shrub	Paste of leaves, used externally.	Antiseptic for cuts, wounds and sores.	N
156.	<b>Lepidopetalum jackianum</b> (Hiern.) Radlk. (SAPINDACEAE) Tree	Leaves with the leaves of <i>Syzygium</i> <i>samarangense</i> are pounded and mixed in pig blood and applied on the body.	As febrifuge and to cure body pain.	N
157.	<b>Lepisanthes rubiginosa</b> (Roxb.) Leenh. 'Cham – Yev, Chamraw' (N) (SAPINDACEAE) Tree	Leaf juice with <i>Breynia</i> <i>retusa</i> in water taken orally.	To check irregular menstrual cycle and pregnancy, stomach-ache, fever and other gynaecological disorders.	N

1	2	3	4	5
158.	<b>Macaranga indica</b> Wight 'Kinsul, Kinnil' (N) (EUPHORBIACEAE) Tree	Warm decoction of leaves. Leaf paste smeared externally.	Gastric disorders and stomachache. Hydrocele.	N N
159.	<b>Macaranga tanarius</b> (L.) Muell.- Arg. 'Petwang' (S), 'Alle' (GA), 'Panah' (N) (EUPHORBIACEAE) Tree	Decoction of leaves taken orally. Raw meat is placed between the leaves of this species and baked by means of heated stones. The chief concern appears to be that the whole leaves should be wrapped so that none of the juices to be dried up.	Stomach disorder. Meat thus prepared is said to remain fresh for several days. Antibacterial.	S GA N & S
160.	<b>Maesa ramentacea</b> (Roxb.) A. DC. 'Hing - Kwai' (N) (MYRSINACEAE) Tree	A paste is made by the leaves, coconut oil and sea water collected from puddles after low tide is being massaging on the belly during delivery.	To facilitate easy, painless delivery.	N
161.	<b>Magnolia andamanica</b> (King) Raju & Nayar 'Soye' (GA) (MAGNOLIACEAE) Tree	Meat is baked in leaves of this species.	To keep it fresh for several days, also antibacterial and antifungal.	GA
162.	<b>Mallotus peltatus</b> (Geisel.) Muell. -Arg. 'Patage' (O), 'Kalokvak' (N) (EUPHORBIACEAE) Tree	Raw leaves taken orally. *The tender soft leaves are spread by the Onge women between hips and beneath back at the time of delivery and also put beneath her genital part (bul) during menses. Leaf - paste rubbed on body.	Abdominal pain For easy parturition and for painless menses. As muscular relaxant.	O O & N N
163.	<b>Manilkara littoralis</b> (Kurz) Dub. 'Sikata' (GA) (SAPOTACEAE) Tree	Bark is being tied around the belly after delivery. Women sometimes use an apron, consisting of one to six leaves, to cover their genital area. The leaves are not spread out so as to cover a wide surface, but are laid one above the other and removed separately as each becomes stiff and shrivelled.	To restore the normalcy of the abdomen in women. To look beautiful and fresh for longer time than others and also as antibacterial.	O & N GA
164.	<b>Melastoma malabathricum</b> L. 'Tinrok' (N) (MELASTOMACEAE) Shrub	Pounded leaves boiled with coconut oil and used externally.	In rheumatic pain.	N

1	2	3	4	5
165.	<b>Millingtonia hortensis</b> L. f. 'Ikritie' (K) (BIGNONIACEAE) Large tree	Leaves paste with fresh leaves of <i>Kaemferia rotunda</i> and bark of <i>Citrus medica</i> . In this mixture add paste of Dugong ( <i>Paani soova</i> ) bone, Whale bone ( <i>Bada machi</i> ) and self holing stone ( <i>Cheda patthar</i> ) is mixed. The diluted above mixture in water applied externally on the head and temples with the help of needle prepared with bat's bone.	Headache, bodyache and intermittent fever.	K
166.	<b>Mimusops elengi</b> L. 'Bakul' (J & S) (SAPOTACEAE) Tree	Fresh tender twigs used as such.	As tooth brush to relieve pain in swollen gums and toothache.	J & S
167.	<b>Mirabilis jalapa</b> L. (NYCTAGINACEAE) Herb	Leaves paste applied externally.	For boils and burns.	O
168.	<b>Momordica cochinchinensis</b> (Lour) Spreng. – 'Kankara' (O) & (H) (CUCURBITACEAE) Twiner	*Tender fruits paste is used externally.	For lumbago, fracture and ulceration.	O & S
169.	<b>Morinda citrifolia</b> L. – 'Nibase, Lurong' (N), 'Surangi, Noni' (H) (RUBIACEAE) Tree	Pounded leaves with leaves of <i>Alstonia macrophylla</i> and fruit sap of <i>Cocos nucifera</i> taken orally. Its leaves mixed with leaves of <i>Colubrina asiatica</i> and young plant of <i>Ficus ampelas</i> and boiled in pig fat and coconut oil.	Stomach disorder.  Applied in the form of a bandage on fractured bone.	S & N  N
170.	<b>Musa paradisiaca</b> L. – 'Kela' (H) (MUSACEAE) Rhizomatous shrub	Stem juice used externally. Juice of spadix mixed with sugar and taken orally by women.	For otalgia.  To check bleeding in urine.	J, O & S  N
171.	<b>Musa textilis</b> Nees (MUSACEAE) Rhizomatous shrub	Roots powder in water.	As anthelmintic.	J & O
172.	<b>Myristica andamanica</b> Hook. f. 'Kinhanmo' (N), 'Oro' (J) (MYRISTICACEAE) Tree	Pounded bark and seed decoction taken orally. Leaf and twigs made as garland and worn. *Leaves paste.	Skin diseases and in fever. Relief in sickness. Cuts and wounds.	S & O J S, J & O
173.	<b>Nervilia aragoana</b> Gaud. (ORCHIDACEAE) Terrestrial orchid	Tubers extract taken orally.	As a cooling agent.	J, O, N & S

1	2	3	4	5
174.	<b>Nicotiana tabacum</b> L. – ‘ <i>Tambaku</i> ’ (H) (SOLANACEAE) Undershrub	Pounded dried leaves with lime and honey used externally.	Wounds and leech bites.	S
175.	<b>Nymphaea pubescens</b> Willd. ‘ <i>Kamal</i> ’ (H) (NYMPHYACEAE) Aquatic herb	Rhizome extract taken orally.	Diarrhoea.	O
176.	<b>Ochrosia oppositifolia</b> (Lam.) K. Schum. (APOCYNACEAE) Shrub	The leaf juice mixed in equal parts with <i>Colubrina asiatica</i> leaf juice and water, taken orally for 3 to 5 days.	To release and regularise menstrual discharge.	N
177.	<b>Ocimum tenuiflorum</b> L. ‘ <i>Tulsi</i> ’ (H), ‘ <i>Likop</i> ’ (N) (LAMIACEAE) Undershrub	Tender leaves and buds are pounded with <i>Bruguiera gymnorhiza</i> leaves and coconut oil and smear or massage is done on the belly. The leaves of this and of <i>Melastoma malabathricum</i> and <i>Dendrobium crumenatum</i> are mixed with ashes of hen’s feather and coconut oil and rubbed on the body twice or thrice a day.	To relieve labour pains.  To cure malarial fever.	N  N
178.	<b>Ophiorrhiza nicobarica</b> N.P. Balakr. (RUBIACEAE) Undershrub	Paste of leaves applied externally.	Used as antiseptic for cuts and wounds.	S
179.	<b>Oplismenus compositus</b> (L.) P. Beauv. ‘ <i>Kiyop</i> ’ (N) (POACEAE) Grass	Plant paste applied on effected portion of the body.	Snake bite.	N
180.	<b>Oropea katschallica</b> Kurz – ‘ <i>Toyoge</i> , ‘ <i>Tanjoge</i> , ‘ <i>Tonyoge</i> ’ (O), ‘ <i>Tapileialo</i> ’ (N) (ANNONACEAE) Shrub	Leaves paste, juice of plant and vapours. Leaves mixed with pig’s blood are applied on the body.	As honey bees repellent. As febrifuge.	O, N & S N
181.	<b>Oxalis corniculata</b> L. ‘ <i>Tapopuri</i> ’ (K), ‘ <i>Amrul sag</i> ’ (H) (OXALIDACEAE) Herb	Plant paste with <i>Centella asiatica</i> , <i>Ancistrocladus extensus</i> , <i>Schefflera elliptica</i> leaves and <i>Curcuma longa</i> rhizome is applied externally.	In bone fracture.	K
182.	<b>Oroxylum indium</b> (L.) Kurz (BIGNONIACEAE) Tree	*Tender fruits & seeds powder with water taken orally in the early morning.	As stomachic and purgative.	GA & O



1	2	3	4	5
183.	<b>Pandanus leram</b> Jones ex Fontane 'Kavera' (H), 'Keera' (N), 'Thadow, Paliyu' (J) (PANDANACEAE) Tree	Leaf and roots tied to body. Roots are crushed in coconut oil and paste is applied externally on urinogenital organs.	For relief in body pains. To check venereal diseases.	J N
184.	<b>Pandanus odoratissimus</b> L. f. 'Oro' (GA), 'Kewra' (H) (PANDANACEAE) Tree	Leaves and inflorescence are used to make cigar.	As a substitute for tobacco in cigar.	GA
185.	<b>Pangium edule</b> Reinw. 'Dello' (GA) (FLACOURTIACEAE) Tree	Meat is baked in leaves of this species.	To keep well and fresh for several day – as antifungal and antibacterial.	N
186.	<b>Passiflora foetida</b> L. 'Kin – vaal' (N) (PASSIFLORACEAE) Climber	Fresh pulp of fruits paste applied externally. Leaf – juice dropped in eyes.	As cooling agent. Eye infections.	J & O N
187.	<b>Peperomia pellucida</b> (L.) Kunth 'Votok' (N), 'Mukhatbila' 'Paan patti' (K) (PEPEROMIACEAE) Creeper	Extract of plant juice taken orally. Plant paste applied externally. Leaves are boiled in pig oil or coconut oil.	Urinary trouble. Cuts, wounds, headache and fever. Rubbed on the body of newly born child, it works as a renovating and also applied to the football players as it is considered to be useful for muscular strength.	N K N
188.	<b>Phrynium pubinerve</b> Blume (MARANTACEAE) Rhizomatous herb	*Rhizome extract taken orally.	Intestinal diseases.	J & O
189.	<b>Phyllanthus amarus</b> K. Schum. & Thonn. – 'Katai' (GA), 'Kin - fiayem' (N), 'Bhuiamla', 'Jaramla' (H) (EUPHORBIACEAE) Herb	Plant decoction taken orally. Leaf paste applied externally.	Dysuria , stomachache and liver disorders. Against the bite of centipedes and snake is claimed to be a good antidote.	N GA & N
190.	<b>Phyllanthus emblica</b> L. 'Aonla' (K), 'Kupu-utoh' (N) (EUPHORBIACEAE) Tree	Leaf extract taken orally. Fresh fruit paste with <i>Acorus calamus</i> and <i>Curcuma longa</i> rhizome in water taken orally.	Vomiting. Weakness after abortion.	K & N All
191.	<b>Phyllanthus debilis</b> Klein ex Willd. 'Jar-amla, Bhui-amla' (K) (EUPHORBIACEAE) Herb	Plant paste with sugar candy and goat milk mixtures taken orally for 3 days in the morning without taking anything. During this treatment there should be complete prohibition of frying food and non-	Jaundice.	K

1	2	3	4	5
		vegetarian food for the patient. Milky latex applied externally.	Sores and scabies.	GA & N
192.	<b>Physalis minima</b> L. (SOLANACEAE) Herb	Leaves and fruits extract taken orally.	As a purgative and diuretic.	O
193.	<b>Pinanga manii</b> Becc. (ARECACEAE) Tree	Tender twigs, leaves and petioles.	As antiseptic, earache and to expel ringworms.	S & N
194.	<b>Piper betle</b> L. 'Pann pati' (K), 'Intoto' (J) (PIPERACEAE) Twiner	*Leaves wrapped on body. Leaves of this plant with the leaves of <i>Acorus calamus</i> boiled and vapour inhaled in the night. Leaf juice taken orally at the time of delivery.	For relief in body pain. Headache, cold, cough and fever. For painless delivery.	J K N
195.	<b>Planchonella obovata</b> (R. Br.) Pierre (SAPOTACEAE) Tree	Wood is burnt before delivery. The juice of the leaves mixed with pig-blood smeared on the belly of a pregnant woman.	Fumes as antiseptic. To protect the child from evil spirit before delivery.	N N & S
196.	<b>Plumeria rubra</b> L. 'Champa' (H) (APOCYNACEAE) Shrub	Bark rubbed on the tongue. Milky latex rubbed on bleeding gums.	As a tongue cleaner and mouth freshner. As toothache and carious teeth.	K All
197.	<b>Polyalthia jenkinsii</b> (Hook. f. & Thoms.) Hook. f. & Thoms. 'Khibirtez' (GA) (ANNONACEAE) Tree	Paste, juice and vapours obtained by chewing the leaves and sprayed by mouth on honeybees Sometimes further use of the chewed stalks is made to drive off the last defenders of the hive.	As honey bee repellent.	GA
198.	<b>Pongamia pinnata</b> (L.) Pierre 'Biochune' (O), 'Thinwin' (N), 'Theep' (GA) (FABACEAE) Tree	*Bark and leaves extract taken orally. Fresh decoction of bark gargle in the night and morning. Bark and leaves are boiled and the water is used for bathing twice or thrice daily.	Intermittent fever, malarial fever and as tooth brush. As a toothache, mouth freshener and in pyrrhoea. To cure fever.	O, N & K K GA
199.	<b>Pothos scandens</b> L. (ARACEAE) Climber	Leaves mixed with pig's blood and given to pet dogs.	To make them healthy.	N
200.	<b>Premna corymbosa</b> (Burm. f.) Rottl. & Willd. (VERBENACEAE) Tree	Leaves are made into a paste with pig blood and applied on the body during body pain.	To cure fever and also in rheumatic pain.	N & O

1	2	3	4	5
201.	<b>Premna pyramidata</b> Wall. ex Schauer. 'Tomonja' (N) (VERBENACEAE) Tree	Paste of leaves with pig blood, smeared on effected body parts.	Body pain, cough and rheumatic pain.	N
202.	<b>Premna serratifolia</b> L. 'Tamonja' (O), 'Chawro' (VERBENACEAE) Shrub	Raw fruits eaten. Leaf-paste is used externally.	Cough. Against body pain.	O GA
203.	<b>Pterospermum acerifolium</b> Willd. 'Ong' (GA) (STERCULIACEAE) Tree	Meat baked in leaves.	To keep fresh and well for several days – as antibacterial and antifungal.	GA
204.	<b>Pseuduaria prainii</b> (King) Merr. 'Hoomal' (J)(ANNONACEAE) Tree	Leaves wrapped around body.	For cough & cold relief.	J
205.	<b>Psychotria sarmentosa</b> Blume (RUBIACEAE) Root climber	Paste of leave with pig blood. Leaves paste in pig blood is applied on complete body.	For body pain. To cure body pains.	N N
206.	<b>Rauvolfia serpentina</b> (L.) Benth. ex Kurz 'Chotachand' (O & S) (APOCYNACEAE) Shrub	Watery juice dropped in eyes.	To reduce opacity of the cornea.	O & S
207.	<b>Rinorea bengalensis</b> (Wall.) O. Kuntze 'Tavo' (GA)(VIOLACEAE) Shrub	Bark is pounded into a paste and some applied externally.	Chest pain, colds, coughs, dysentery, headache, facial application of leaves is believed to aid in finding one's way through the jungle.	GA
208.	<b>Rinorea macrophylla</b> (Decne) O. Kuntze 'Gene, takhkho' (GA) (VIOLACEAE) Tree	Bark and leaves are powdered and made into paste with water.	Smear on breast to promote lactation.	GA
209.	<b>Ryparosa javanica</b> (Blume) Kurz (FLACOURTIACEAE) Tree	Leaf decoction taken orally.	To cure sensation of frequent urination.	N
210.	<b>Salacia chinensis</b> L. 'Lana - cho' (N) (CELASTRACEAE) Climber	Leaf paste of this plant and the leaves of <i>Azadirachta indica</i> along with coconut oil is rubbed on the belly.	For relieving labour pains.	N
211.	<b>Samanea saman</b> (Jacq.) Merr. 'Too-na-ka' (N) (MIMOSACEAE) Tree	Extract of leaves dropped in eyes. Leaf - juice applied externally.	Conjunctivitis. On cuts and wounds.	N & S N
212.	<b>Scaevola sericea</b> Forst. f. ex Vahl 'Kwyae' (N, O), 'Tuful' (N) (GOODENIACEAE) Shrub	*Paste of leaves applied externally. Mature fruits eaten as such.	Rheumatic pain and bone fractures. Curing fever, cough and headache.	O & N N, S & O
213.	<b>Schefflera elliptica</b> (Blume) Harms. 'Daandaulase' (K) (ARALIACEAE) Tree	Seed oil used externally. Leaf paste with the rhizome of <i>Curcuma longa</i> , banana fruits,	Skin diseases. Bone fracture.	S S

1	2	3	4	5
		eggs and honey applied externally.		
214.	<b>Semecarpus kurzii</b> Engler 'Bip' (S), 'Pep' (N) (ANACARDIACEAE) Tree	Paste of fruits applied externally. Fruit eaten as such.	Cuts and wounds. Injuries.	S N & S
215.	<b>Senna alata</b> (L.) Roxb. 'Thinbaw, Palal' (N) (CAESALPINIACEAE) Shrub	Leaves paste and leaf- juice applied externally.	Sores and skin diseases.	N & S
216.	<b>Senna occidentalis</b> (L.) Link 'Uhutesimil' (K), 'Marohah' (N), 'Kasondi' (H) (CAESALPINIACEAE) Shrub	Pounded leaves in pig oil to make a paste on the body. Seed paste in water applied externally and taken orally also.	Fever, boils and wounds.  Against centipede bite.	N  N & R
217.	<b>Senna surattensis</b> (Burm. f.) Irwin & Barneby (CAESALPINIACEAE) Shrub	Bark and leaves powder with water taken orally.	To cure diabetes and gonorrhea.	O
218.	<b>Sida acuta</b> Burm. f. (MALVACEAE) Undershrub	The aqueous extract of the leaves of this plant and leaves of <i>Ficus</i> <i>gibbosa</i> are taken orally.	To cure urine obstruction.	N
219.	<b>Solanum erianthum</b> D. Don 'Roiluvam' (N) (SOLANACEAE) Shrub	Leaf – juice in water taken orally.	For easy delivery.	N
220.	<b>Sphyranthra lutescens</b> (O. Kuntze) Pax – 'Nyaiyo' (N) (EUPHORBIACEAE) Tree	Fresh decoction of leaves taken orally.	For fever and muscular pains.	N
221.	<b>Spilanthes paniculata</b> Wall. ex DC. 'Gasoohati' (K) (ASTERACEAE) Herb	Leaf-paste applied externally. *Boiled extract of plant applied on the effected gums and teeth.	On cuts and wounds.  Toothache.	K  N, S & O
222.	<b>Stachytarpheta jamaicensis</b> (L.) Vahl (VERBENACEAE) Undershrub	Paste of the leaves is boiled in coconut 'tari' and given orally.	To check fever after delivery.	N
223.	<b>Stephania andamanica</b> Diels (MENISPERMACEAE) Twiner	*Extract of tubers taken orally.	Fever and urinary troubles.	GA, J & O
224.	<b>Sterculia rubiginosa</b> Vent. 'Shawni' (N), 'Fuk' (N) (STERCULIACEAE) Tree	Decoction of leaves taken orally. Pounded leaves with pig blood. A paste of this plant along with the leaves of <i>Clerodendrum</i> <i>paniculatum</i> is mixed in water and taken orally. Leaves of this with the leaves of <i>Clerodendrum</i>	For fever, asthma, cold and cough. Fever.  To check bleeding in urine.  To cure body ache, fever and asthma.	N  S, N & O  N & S  N

1	2	3	4	5
		<i>paniculatum</i> are mixed with the pig blood and smeared on throat, chest and back.		
225.	<b>Streblus asper</b> Lour. – ‘ <i>Siora</i> ’ (GA) (MORACEAE) Tree	Milky latex applied externally.	As antiseptic and astringent.	GA & N
226.	<b>Strychnos andamanensis</b> A. W. Hill (STRYCHNACEAE) Tree	Leaves decoction taken orally.	For curing urine obstruction.	N
227.	<b>Syzygium samarangense</b> (Blume) Merr. & Perry – ‘ <i>Mi-lul, Kalitngench</i> ’ (N) (MYRTACEAE) Tree	Leaf juice with coconut oil. Fruits juice taken orally.	Rheumatic pain and lumbago. As a cooling agent.	N & S N
228.	<b>Tabernaemontana crispa</b> Roxb. ‘ <i>Saunch, Thikaro - thung</i> ’ (N, O), <i>Koraya</i> ’ (H) (APOCYNACEAE) Shrub	Paste of fruits with water. *Decoction of leaves taken orally. Crushed leaves of this plant with the leaves of <i>Abrus precatorius</i> mixed in water taken orally. Milky juice applied externally.	Dysentery. Stomachache, body pain and ulcers. To check bloody discharge in urine. To cure eye diseases.	N & O N, S & O N N & S
229.	<b>Tacca leontopetaloides</b> (L.) Kuntze ‘ <i>Saunch</i> ’ (N & S) (TACCACEAE) Shrub	Plant juice taken orally.	As antipyretic.	N & S
230.	<b>Terminalia bialata</b> Steud. (COMBRETACEAE) Tree	Fresh kernels given after delivery.	For recovery after delivery.	GA & N
231.	<b>Terminalia catappa</b> L. – ‘ <i>Chap</i> ’ (GA) (COMBRETACEAE) Tree	Paste of leaves applied externally. Leaf juice of this with the leaf juice of <i>Syzygium samarangense</i> and <i>Alchornea rugosa</i> with the juice of dry endosperm of coconut taken orally as well as smear on the belly.	Skin infection. As abortifacient.	GA N
232.	<b>Teijsmanniodendron pteropodum</b> (Miq.) Bakh. (VERBENACEAE) Tree	Leaf decoction, taken orally.	Used in abortion.	N
233.	<b>Thespesia populnea</b> (L.) Sol. ex Corr. <i>Tebokala</i> ’ (O) (MALVACEAE) Tree	Raw leaves with water taken orally.	Constipation.	O
234.	<b>Thottea tomentosa</b> (Blume) Ding - Hou ‘ <i>Udupet</i> ’ (J) (ARISTOLOCHIACEAE) Herb	*Almost whole plant tied around body.	To cure fever, cold and cough.	J
235.	<b>Tinomiscium petiolare</b> Hook. f. & Thoms. (MENISPERMACEAE) Climber	Milky sap applied externally. Dry fruit powder. Seeds eaten.	Rheumatic pains. As fish poison. Edible and as tonic.	N J N & S

1	2	3	4	5
236.	<b>Tournefortia ovata</b> Wall. ex G. Don 'Ka-Vap' (N) (BORAGINACEAE) Shrub	Fresh leaf extract taken orally.	Against body pain.	N
237.	<b>Trema tomentosa</b> (Roxb.) Hara 'Teu, Buckri-pathi' (N) (ULMACEAE) Tree	Leaves are boiled in hen's blood and rubbed on forehead.	To cure headache.	N & local Inhabitants
238.	<b>Trichosanthes bracteata</b> (Lam.) Voigt 'Kula-chaul' (N), 'Urubethe' (J) (CUCURBITACEAE) Climber	Extract of tender leaves applied externally. Whole plant wrapped around the throat.	Inflammation. To cure throat infections.	N J
239.	<b>Triumfetta rhomboidea</b> Jacq. 'Kasim - rioch, Thiathi' (N) (TILIACEAE) Herb	The crushed leaves with rhizome of <i>Zingiber officinalis</i> , lemon juice and coconut oil. Decoction of roots.	Asthma, cough, cold and as blood purifier. Cough and cold.	N N, O & S
240.	<b>Typhonium roxburghii</b> Schott. (ARACEAE) Rhizomatous herb	Tubers extract taken orally.	To reduce strain.	O
241.	<b>Urena lobata</b> L. - 'Kasinrih, Sapathra' (N, S, K) (MALVACEAE) Herb	Pounded leaves with coconut oil applied externally. Leaves paste applied on head. *Leaf juice dropped in eyes. One spoon of freshly boiled rice, rolled in seven equal sized leaves of this plant. Through this roll, air is whooped into the eyes for seven times and the same roll must be thrown backside only. Decoction of the leaves of this plant and <i>Cyclea peltata</i> taken orally.	Cuts and wounds. Check hair loss. Conjunctivities. Conjunctivities. To check post natal problems like pains and reduces abdominal swellings.	N & S N & S N & O K N
242.	<b>Vernonia cinerea</b> (L.) Less. - 'Hopal' (N) (ASTERACEAE) Herb	Leaves with <i>Modecca cardiophylla</i> , <i>Solanum incanum</i> and <i>Scaevola sericea</i> are boiled in coconut oil and pig fat, and rubbed on the body.	To cure the patient suffering from fever, rheumatism and other ailment for long time.	N
243.	<b>Wedelia biflora</b> (L.) DC. 'Kotan' (N, O, S, J) (ASTERACEAE) Herb	Leaf juice with lime applied externally. Leaves of <i>Scaevola taccade</i> are pounded and mixed in hen's blood are rubbed on the children body.	Antiseptic for cuts and wounds. As a febrifuge, headache and fever.	N, O, S & J N



1	2	3	4	5
244.	<b>Wrightia arborea</b> (Dent.) Mabblerley (APOCYNACEAE) Tree	Latex yield yellow dye and applied externally.	Dry latex used in clouration to clothes and to stop haemorrhage.	N, S & J
245.	<b>Zingiber odoriferum</b> Blume (ZINGIBERACEAE) Rhizomatous herb	Stem and petioles juice.	As a tranquilizer for honey bee.	J & O
246.	<b>Zingiber squarrosus</b> Roxb. (ZINGIBERACEAE) Rhizomatous herb	*Plant sap applied externally. Plant extract and petioles taken orally.	As bee - repellent. Chewed to quench thirst.	N, O, S & J S, J & O
247.	<b>Zingiber zerumbet</b> (L.) Rosc. ex J. E. Sm. 'Pothako' (K) (ZINGIBERACEAE) Rhizomatous herb	Powdered dried rhizome inhaled. Rhizome extract taken orally.	Cold, cough, fever and giddiness. As cooling agent.	KO
GYMNOSPERMS				
248.	<b>Cycas rumphii</b> Miq.- 'Chatale' (GA) 'Turiella, Tiwan' (N), 'Arguna' (H) (CYCADACEAE) Tree	Seeds pulp is applied externally. Seeds eaten as such.	Stomach pain. As health tonic.	GA & N N
249.	<b>Gnetum gnemon</b> L. (GNETACEAE) Tree	Leaf paste mixed in coconut milk is smeared on abdomen. Leaf - paste applied externally.	Labour pains and other gynaecological disorders. Against snake bite.	N N & S
250.	<b>Gnetum montanum</b> Markgraf (GNETACEAE) Climber	Stems pieces taken as such and its distillation for wine making.	As antiperiodic and also beverages making.	N
251.	<b>Podocarpus neriifolius</b> D. Don (PODOCARPACEAE) Tree	Decoction of the leaves taken orally.	Rheumatism and painful joints.	N
252.	<b>Podocarpus wallichianus</b> Presl. (PODOCARPACEAE) Tree	Decoction of leaves taken orally.	Joints pain.	N
253.	<b>Thuja plicata</b> D. Don (CUPRESSACEAE) Tree	Distillation of twigs and leaves yields an essential oil which is dropped in eyes.	Eye infections.	R
PTERIDOPHYTES				
254.	<b>Acrostichum aureum</b> L. 'Khadi-bhaji' (H) (ACROSTICHACEAE) Terrestrial fern	Rhizome paste applied externally.	Wounds and boils.	N, O & R
255.	<b>Adiantum philippense</b> L. (ADIANTACEAE) Terrestrial fern	Pounded leaves applied externally.	Wounds, swelling in the neck.	N
256.	<b>Angiopteris evecta</b> (Forst.) Hoffm. (ANGIOPTERIDACEAE) Terrestrial fern	Leaf juice taken orally.	Cough.	N
257.	<b>Angiopteris lygodifolia</b> Rosc.ust (ANGIOPTERIDACEAE) Terrestrial fern	Fresh fronds tied around the chest.	To cure cold and cough.	J

1	2	3	4	5
258.	<b>Asplenium falcatum</b> Lam. (ASPLENIACEAE) Epiphytic fern	*Leaves decoction taken orally. Rhizome powder with water taken orally.	Jaundice and malarial fever. As an anthelmintic.	O & N N
259.	<b>Asplenium nidus</b> L. (ASPLENIACEAE) Epiphytic fern	Pounded leaves mixed with grated coconut.	Against feverish head and hair care.	N & O
260.	<b>Blechnum orientale</b> L. (BLECHNACEAE) Terrestrial fern	Pounded rhizome applied externally.	Antidote against swellings, boils and anthelmintic.	N
261.	<b>Cephalomanes javanicum</b> Blume Terrestrial fern	Leaves mixed garlic and onion, it may be smoked.	Skin complaint.	N
262.	<b>Ceratopteris thalictroides</b> (L.) Ad. Brongn. (CERATOPTERIDACEAE) Marshy fern	Fronds as poultice and applied externally.	Enlarged abdomen, the bath to clean newly borne baby and mother having venereal diseases.	N
263.	<b>Dicranopteris linearis</b> (Burm. f.) Undrew. (DICRANOPTERIDACEAE) Fern	Fronds & Rhizomes fresh decoction taken orally. Warm leaf paste in coconut oil. Rhizome extract taken orally.	As an anthelmintic, asthma, fever and antibacterial properties. Hydrocele & painful testicles. As anthelmintic.	N N N & S
264.	<b>Diplazium esculentum</b> (Retz.) Sw. (ATHYRIACEAE) Terrestrial fern	A decoction from rhizome and leaves taken orally.	Haemoptysis cough and fever.	N
265.	<b>Drymoglossum heterophyllum</b> (L.) Trimen (POLYPODIACEAE) Epiphytic fern	Plants pounded with gypsum used externally. Crushed leaves and sap of leaves taken orally.	On itch and skin sores. Styptic to stop capillary hemorrhages, eczema, coughs, constipation and gonorrhoea.	N N
266.	<b>Drynaria quericifolia</b> (L.) J. Sm. (POLYPODIACEAE) Epiphytic fern	Warm plant paste in coconut oil applied externally. Fronds poultice tied around affected body parts. Rhizome along with stem of <i>Cissus</i> and <i>quadrangularis</i> <i>Zingiber officinale</i> in paste form. Rhizome extract taken orally. Leaves are pounded with pig's blood and smeared on the body.	Relief in labour pains. Swellings, headache and rheumatic pains. Applied on bone fracture in cattle. Fever, cough. As febrifuge.	N N O & S N N

1	2	3	4	5
267.	<b>Helminthostachys zeylanica</b> (L.) Hook. (HELMINTHOSTACHYACEAE) Terrestrial fern	Young fronds decoction applied externally.  Fresh leaf juice.	On boils, ulcers, stomachic and an appetizer for babies.  Relieves blisters on the tongue.	N  N & S
268.	<b>Lycopodium cernua</b> (L.) Franco. & Vasc. (LYCOPODIACEAE) Epiphytic fern	Leaves decoction is used as a lotion.	Beri-beri, cough, skin eruptions and uneasiness in the chest.	N
269.	<b>Lygodium circinatum</b> (Burm. f.) Sw. (LYGODIACEAE) Terrestrial fern	The sap from the roots and leaves with a little <i>Curcuma longa</i> made into a paste, applied externally.	On sprained or bruised limbs and also applied on wounds of bite of a black terrestrial spider, also used in rheumatic pains.	N
270.	<b>Lygodium flexuosum</b> (L.) Sw. (LYGODIACEAE) Terrestrial fern	Fresh roots paste is used externally.	For rheumatism, sprains, scabies cut wounds and carbuncles. The spores are reported to be important in the treatment of high fever.	N
271.	<b>Lygodium microphyllum</b> (Cav.) R. Br. (LYGODIACEAE) Terrestrial fern	Decoction of rhizomes, leaves taken orally and leaves poultices applied externally.	Dysentery, skin diseases, swellings, colds and cough.	N & S
272.	<b>Marsilea minuta</b> L. (MARSILEACEAE) Marshy fern	The whole plants extract used orally.	Inseminial, sedative and convulsion properties.	N, R & S
273.	<b>Microlepia speluncae</b> (L.) Moore (DENNSTEADTIACEAE) Terrestrial fern	Leaves decoction taken orally.	Fever.	N
274.	<b>Microsorium punctatum</b> (L.) Copel (POLYPODIACEAE)) Epiphytic fern	Whole plants paste smear externally and also taken orally.	Against snake bite.	N
275.	<b>Nephrolepis biserrata</b> (Sw.) Schott (NEPHROLEPIDACEAE) Epiphytic fern	Fresh leaves juice and decoction used externally.	Bleeding of cuts as coagulate agent and cough.	N
276.	<b>Onychium siliculosum</b> (Desv.) C. Chr. (PTERIDACEAE)	A decoction of the fronds & their juice taken orally.	Dysentery and falling hairs.	N
277.	<b>Ophioderma pendulum</b> L. (OPHIOGLOSSACEAE) Epiphytic fern	The fronds are shedded into coconut oil and applied externally.	As an ointment in the scalp to improve the hair.	N
278.	<b>Phymatosorus scolopendria</b> (Burm.) Pich.-Ser. (POLYPODIACEAE)) Epiphytic fern	The young fronds taken orally and kept as such on beds. Paste of the plant along with the leaves of <i>Clerodendrum</i>	Dysentery, gonorrhoea and also to keep off bed bugs. To check bloody discharge in urine.	N  N

1	2	3	4	5
		<i>paniculatum</i> and <i>Sterculia rubiginosa</i> in water taken orally.		
279.	<b>Pityrogramma calomelanos</b> (L.) Link (HEMIONITIDACEAE) Terrestrial fern	A decoction of roots and pounded fronds taken orally.	For dysentery, by rubbing on the back of a person in malaria, and in kidney trouble.	N
280.	<b>Psilotum nudum</b> (L.) P. Beauv. (PSILOTACEAE) Epiphytic fern	The oily spores.	Given to infants to check diarrhoea.	N
281.	<b>Pteridium aquilinum</b> (L.) Kuhn (PTERIDACEAE) Terrestrial fern	Rhizome sap taken orally.	Chronic disorders of spleen.	A & O
282.	<b>Pteris ensiformis</b> Burm. f. (PTERIDACEAE) Terrestrial fern	Rhizome juice applied externally.	On glandular swellings of the neck.	N
		*Decoction of the leaves taken orally as well as applied externally.	For malaria, gonorrhoea and externally it is wash for boils, bodies and hemorrhoides.	N & J
283.	<b>Pteris vittata</b> L. (PTERIDACEAE) Terrestrial fern	Rhizomes after boiling taken with water.	Acts as demulcent.	N
284.	<b>Pyrrosia adnascens</b> (Sw.) Ching (POLYPODIACEAE) Epiphytic fern	Juice from the pounded fronds taken orally.	For dysentery and for burns.	N
285.	<b>Selaginella ciliaris</b> (Retz.) Spreng. (SELAGINELLACEAE) Terrestrial fern	An infusion of the plants taken orally.	High fever and also in skin troubles and the ashes are used in a liniment for backache, rheumatism & lumbago.	N
286.	<b>Sphaeropteris albo-setacea</b> (Bedd.) Tryon (CYATHEACEAE) Terrestrial fern	Pounded leaves with black pepper.	Wounds and sores.	N
287.	<b>Stenochlaena palustris</b> (Burm. f.) Bedd. (STENOCHLAENACEAE) Terrestrial fern	Decoction of leaves and leaf juice taken orally.	For pregnancy, fever, stomachache & skin diseases.	N
288.	<b>Vittaria elongata</b> Sw. (VITTARIACEAE) Epiphytic fern	Leaves extract taken orally.	Rheumatism and stiffness of swollen joints.	N
		ALGAE		
289.	<b>Sargassum wightii</b> Grev. 'Chawpho' (GA) (SARGASSACEAE) Algae	This Alga is rubbed on whole body.	To treat acute malarial fever, according to tribals, relief is very quick.	GA

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## अंडमान निकोबार द्वीपसमूह, भारत में आदिवासियों के नृचिकित्सकीय पौधे

आर.पी. पांडे, एल. रसिंगन व जी. एस. लकड़ा

### सार संक्षेप

इस शोधपत्र में 116 कुलों के अंतर्गत 233 जेनेरा की 289 पादप जातियों के नृचिकित्सकीय उपयोगों की जानकारी है। इनमें आवृतबीजी की 247 जातियाँ (87 कुलों के 198 जेनेरा), आनवृतबीजी की 6 जातियों (4 कुलों के 4 जेनेरा), टेरिडोफाइट की 35 जातियाँ (24 कुलों के 30 जेनेरा) तथा शैवाल की एक जाति शामिल हैं। आदिवासियों की अपनी भाषाएं, परम्परा एवं संस्कृति है। आदिवासियों द्वारा विभिन्न पादप जातियों के उपयोग का तालिका में वर्णानुक्रम में पौधों के नाम, उनके वनस्पतिक नाम, स्थानीय नाम, कुल के नाम, पौधे की प्रकृति, पौध के उपयोगी भाग, रोग एवं आदिवासी नाम दिए गए हैं।

## PHYTODIVERSITY OF THE NARAYAN SAROVAR WILDLIFE SANCTUARY, KACHCHH, GUJARAT, INDIA

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### ABSTRACT

The present paper deals with an account of vegetation, floral composition and analysis, forest types and its associations. It comprises 455 species of vascular plants, under to 247 genera and 74 families. Besides this, important economic plants of bioperspective nature, a list of 13 cultivated/ crop plants and their 14 wild relatives, 39 rare, threatened and endemic taxa which need effective conservation measures for maintenance of germplasm.

**Keywords :** Gujarat, Kachchh, Narayan Sarovar Wildlife Sanctuary, Phytodiversity, Rare, Threatened.

### INTRODUCTION

Narayan Sarovar Wildlife Sanctuary, located in the western most part of the country, is locally known as 'Naransar'. It is a place of pilgrimage and is about 2 km from Koteswar. Koteswar is one of the 12th Jyoti Linga of Lord Shiva in India. The temple of Lord Shiva constructed during 18th century is the main attraction of the place. Narayan Sarovar is considered to be one of the five holy lakes in India whose importance is narrated in the Hindu scriptures *Shrimad Bhagwat*, *Vayu Purana*, *Vishnu Purana*, etc.

The practice of conservation of natural resources in the Kachchh goes way back to the princely times when certain resource rich areas were given legal protection by declaring them as "Rakhals" (reserve forests). The objective behind this was to ensure the availability of big game as well as fodder to the livestock during scarcity.

Period of 1970-1990 may be considered to be a period of serious attempts made by the government for the preservation of wild living resources, when a number of areas were notified as Sanctuaries and National Parks. Out of 21 Sanctuaries in Gujarat State, 4 are situated in Kachchh which shows the importance of the area.

Recognizing its unique phyto-geographical position, uncommon ecosystem and its unique biodiversity, in April 1981, State Government notified 765.79 sq km area of 4 rakhals, viz. Gagariana, Ratipal, Kaniyara & Mindhiari as wildlife sanctuary in Lakhpat taluka of Kachchh district, popularly known as Narayan Sarovar Wildlife Sanctuary.

In 1993, an area of 94.87 sq km of Narayan Sarovar WLS, spread over 16 villages was denotified as "Chinkara Wildlife Sanctuary", as Chinkara is the key species of this region; this notification was quashed by hon'ble Highcourt. In 1995, the areas in and around the boundary of the Narayan Sarovar WLS, bounded with rich mineral deposits, forced the State Government to denotify about 321 sq km area and, thus, reduced the Sanctuary to present extent of 444.23 sq km (including village Pakho). Narayan Sarovar is the first Sanctuary, which was denotified by the Government. The settlement work in the Sanctuary is still going on and final notification of the Sanctuary is yet to be issued (Annon., 2001).

The percentage geographical area in the State under the wildlife-protection areas is above the national average of 4.3%. Rodgers & Panwar (1988) have classified India into 10 Biogeographic zones and 25 biotic provinces. Accordingly, Gujarat has four Biogeographic zones and five biotic provinces. Narayan Sarovar Wildlife Sanctuary comes under Biogeographic zone-3 Indian Desert, Biotic province- 3- A Kachchh. This Biogeographic zone comprises four sanctuaries, covering approximately 74% of the total area under protected areas network in the State (*Table 1*).



*Table 1:* Distribution of wildlife protected areas in Biogeographic Zone - 3 Indian Desert, Biotic Province - 3 A Kachchh.

Biogeographic Sub-Div	Area (sq km)	Sanctuary	Area (sq km)
Little Rann	5000	1.Wild Ass Sanctuary	4953.70
Great Rann	10000	2.Desert Wildlife Sanctuary	7506.20
Southern hills	33000	3.Narayan Sarovar WLS	444.23
		4.Kachchh Bustard Sanctuary	12906.10

#### AREA AND TOPOGRAPHY

Narayan Sarovar Wildlife Sanctuary (WLS), lies between 23° 27' - 23° 42' N latitude and 68° 30' - 68° 57' E longitude in Lakhpat taluka of Kachchh district, having a total area of 436.77 sq km. Total forest area is 152.95 sq km, with 119.74 sq km reserved forest and 33.21 sq km unclassified forest. There are 31 villages in the Sanctuary. The tract of the Sanctuary is mainly hilly lying in eastern, north- eastern, south- eastern and with undulating areas interspersed with small hill range extending east- west. Western coastal region have sand dunes and the hummocky plains, interspread with rocky- gravelly plains and gentle slopes towards the sea- coast. Few water bodies like dams; ponds and puddles are also present in the Sanctuary area. The entire western area is an ecotone of intertidal mangrove. The Kori creek surrounds the Sanctuary in the north- west and the mangrove forest on the west. The altitude ranges from 2.7 meter above msl near coastal Tahera village and 157 meter above msl in Manijal hill at Kaniyaro Rakhal.

#### GEOLOGY AND SOIL

The geological formations of Kachchh range is in age from middle Jurassic to late Tertiary periods with unconformities breaking the succession between the middle cretaceous, supra- trappean, middle Kirthar, and finally Miocene & Pliocene. Therefore, the entire Kachchh district may have an effect in epitome of Jurassic and post Jurassic geology of India. Thus, Kachchh is considered to be an eastern extension of the mobile belt then a part of the unfolded and stable peninsular foreland of India.

Geologically Narayan Sarovar WLS area exposes the following rock formations of Jurassic and Cretaceous periods:

- Deccan trap is a basaltic rock, confined to Pandhro in the west and extended to east of Anjar. The lava flows vary from medium grained to aphanites type at times being periphyritic.
- Tertiary formation is exposed in the central part of the Sanctuary and lying as a continuous horizon all along the western, southern and south- eastern coast of Kachchh from Lakhpat in the west to as far as Vandh on the eastern side. The numulitic limestone and shale are exposed bordering the balastic rocks in south and go upto Lakapat.
- Pleistocene formations support coarse sandy limestone, which are massive with forameniferal shells, sand grains and other rock fragments.
- Recent alluvium is recorded as a belt of 5 to 15 km along the coast. Few coastal sand dunes are also present along the western boundary (Anon., 1971).

The Narayan Sarovar WLS represents three major types of soil, viz. sandy- alluvium, clay and black-loam. Alluvium sandy type of soil is restricted to the western coastal bank areas, the clay deposition is present on both northern and southern parts of the sanctuary. Bentonite clay is present in the southern part; it has poor moisture retention capacity and very less permeability. As a result of this, vegetation is very poor in such type of soil. Black loamy soil is found mainly in the central part of the sanctuary. Comparatively, this soil is fertile due to better moisture retention capacity and thus supports better vegetation.

## CLIMATE

Narayan Sarovar WLS has a semi- arid climate, May and June are the hottest months with dusty storms, and day temperature reaches upto 43°C, while December and January are the coldest months. The mean maximum day temperature during winter is about 15°C. The mean annual rainfall is extremely erratic in the region and there are only 8-9 rainy days in a year. The average annual precipitation is 200 to 350 mm. More than 90% of total rain is received during south- west monsoon, which normally set over an area between last week of June and remains active till September. There are considerable variations and fluctuations in the temperature in different months and seasons. The humidity is also quite considerable in the Sanctuary area.

## PREVIOUS WORK AND PRESENT STUDY

The earliest recorded information on plants of Kachchh, provided by Plain (1880). At the time of publication of “Flora of Bombay Presidency” by Cooke (1901 – 08), Gujarat was a part of presidency, and was the least explored part of the presidency, especially North Gujarat and Kachchh, which have been touched only by few visits.

After Cooke, phytodiversity of Kachchh was explored by many workers viz. Blatter (1908 - 09), Thakar (1926), Kapadia (1954a,b), Puri & al. (1959 - 1960), Jain & Deshpande (1960a,b), Jain & Kanodia (1960, Chavan & Sabnis (1962), Bhandari (1965), Kanodia & Nanda (1966), Jain (1968), Rao (1970), Guha Bakshi (1971), Rao & Sabnis (1977), Rao (1981 - 81a), Parmar & Singh (2003) etc, but, there is no published account on phytodiversity of Narayan Sarovar, except an account on ecological status of Narayan Sarovar WLS (Annon., 2001) which provides a list of 255 species of flowering plants. Shah (1978) published a comprehensive account on the phytodiversity of Gujarat. Raghavan & al. (1981) updated this work in form of check list. Recently, Pandey & Singh, (1999), Pilo & al. (1996), Singh & Prabia (2003) and Meena & Pandey (2004) studied the floristic diversity of Gujarat as a whole.

Considering the importance of floral, faunal and its unique ecosystem value of this fragile arid region, Botanical Survey of India, Jodhpur takes initiative to explore the phytodiversity of Kachchh region, with special reference to Narayan Sarovar WLS. During the years 2000 to 2005, five exhaustive and intensive botanical exploration tours of 15 days each, in different seasons have been undertaken. During these visits a total numbers of about 10,000 plant specimens were collected, out of this about 3,500 specimens were only from Narayan Sarovar Wildlife Sanctuary. In the present study a total number of 454 species of flowering plants belonging to 246 genera and 73 families have been enumerated. The specimens have been deposited in the herbarium of Arid Zone Circle of Botanical Survey of India, Jodhpur (BSJO) and Central National Herbarium, Howrah (CAL). Species marked with an asterisk (\*) are included on the authority of Anon., 2001.

## VEGETATION

The Narayan Sarovar WLS represents a unique floral and faunal assemblage of arid ecosystem, and the representative habitat of mixed thorn forest and grasslands / savannas which are well distributed mainly in two zones, viz. Pipar and Mindhiari and partially in Ratipal. The vegetation near hills and the valleys appears more dense and luxuriant during monsoon period; the herbaceous ground cover also flourishes well during the rainy season. During summers and winters, only woody perennial species survive. A huge portion of the area of the Sanctuary exhibits the edaphic climax of the Tropical thorn forest with average tree height 3 to 5 m, except in the areas where anthropogenic pressure or factors have decimated them. Thus, major portion of the Narayan Sarovar WLS comes under thorny scrub jungles and interspersed with grasslands / savannas.

According to classification of forest types of India (Champion & Seth, 1968), the following forest types may be recognised in Narayan Sarovar Wildlife Sanctuary.

### ***Northern tropical dry deciduous scrub type (5B)***

1. 5B/DS1 - Dry deciduous scrub forest.
2. 5B/DS2 - Dry Savannah type forest.
3. 5B/DSE3 - Babul forest (*Acacia nilotica* ssp. *subalata* type).

**Northern tropical thorn forest (6B)**

1. 6B/C1 - Desert thorn forest.
2. 6B/DS2 - Tropical *Euphorbia* scrub type.
3. 6B/E2 - *Acacia senegal* type forest.
4. 6B/ DS2 - *Euphorbia* thorn forest.
5. 6B/ E2 - *Acacia senegal* forest.
6. 6B/C1 - Desert thorn forest.
7. 6B/DS1 - *Ziziphus* scrub forest.
8. 6B/E4 - *Salvadora* scrub forest.
9. 6B/1S1 - Desert dune scrub forest.

On the basis of edaphic factors, the vegetation of the Sanctuary may be classified in to following habitats:

1. Hills and valleys
2. Rocky gravelly undulating plains
3. Sandy hummocky plains with low sand -dunes
4. Western coastal mangroves and saline habitat
5. Marshy / aquatic habitat
6. Weeds

**1. Hills and valleys:** Narayan Sarovar WLS is surrounded from all four sides by hills and valleys with some interspreading areas of hummocky sandy and gravelly rocky plains. A chain of considerable high hills is situated at Mindhiari, Kaniyaro, Chamro, Daulatpar, Subhashpar, Khadak, Bitiyari and Dayapar etc in the eastern side of the Sanctuary. Similarly, in western side, some hills and rock out -crops are also present at Pipar, Ratipal, Nareda, Khirsara and Laxmirani etc. Northern side comprises hills at Narayan Sarovar, from Verma Nagar to Pandhro and up to Dayapar. The southern side also has a continuous chain of hills ranging from Dayapar to Mata-na- Madh and further east up to Nakhtarana.

The most dominating tree species on hills and valleys are: *Acacia senegal* and *Acacia nilotica* ssp. *subalata*, which predominate in the western side having lime stone formation in the gravelly- rocky plains or at the base of hills. The lime stone formations were also recorded at Guhar nani, Guhar moti, Lakki, Gugariyana, Kerwandh, Pipar, Bhutau, Khirsa, and Medi etc. In the hilly region and rocky- gravelly plateau of eastern region, *Acacia senegal* is dominant species and it covers major parts of the reserve forest at Haman Khudi, Halapar, Mudia, Chamro, Mindhiari, Kaniyaro, Subhashpar, Daulatpar, Nareda, Bhudha etc. The common associations observed in this habitat are:

- (i) *Acacia nilotica* ssp. *subalata* with *Salvadora oleoides*, *S. persica*
- (ii) *Capparis decidua* with *Salvadora oleoides*, *Ziziphus nummularia*
- (iii) *Ziziphus nummularia* with *Prosopis juliflora*, *Acacia senegal*
- (iv) *Acacia senegal* with *Capparis decidua*, *Ziziphus nummularia*, *Salvadora oleoides*
- (v) *Ziziphus nummularia* & *Capparis decidua*
- (vi) *Acacia senegal* with *Euphorbia caducifolia*, *Salvadora oleoides* and
- (vii) *Ziziphus nummularia* and *Salvadora oleoides*.

The other common trees and shrubs in these *Rakhals* are: *Acacia leucophloea*, *A. eburnea*, *Balanites aegyptiaca*, *Capparis decidua*, *C. grandis*, *Commiphora wightii*, *Cordia perrottetii*, *Euphorbia caducifolia*,

*Grewia tenax*, *G. villosa*, *Lycium barbarum*, *Premna resinosa*, *Prosopis juliflora*, *P. cineraria*, *Salvadora oleoides*, *S. persica*, *Ziziphus nummularia* etc. At few places *Acacia senegal* and *A. nilotica* ssp. *subalata* are noted at the base of hills. The other associates of these are *Acacia eburnea*, *A. nilotica* ssp. *indica*, *A. tortilis*, *Calotropis procera*, *Senna auriculata*, *Salvadora* spp., *Prosopis* spp. and *Ziziphus nummularia*. In some of the areas of the Sanctuary, *Prosopis juliflora* spreads widely leading to declination of the grass cover and herbaceous ground cover.

The common climber and twiners recorded from hills and valleys are: *Asparagus dumosus*, *A. racemosus*, *Cadaba fruticosa*, *Dalechampia scandens* var. *codofana*, *Ipomoea* spp., *Rhynchosia minima*, *Rivea hypocrateriformis* etc. The ground cover, which is quite luxuriant during monsoon, comprises herbaceous annuals and ephemerals like *Digera muricata*, *Dipteracanthus patulus* var. *alba*, *Indigofera cordifolia*, *Pupalia lappacea*, *Tephrosia purpurea*, *Tribulus terrestris*, *Vernonia cinerea*, together with species of *Amaranthus*, *Boerhavia*, *Cassia*, *Cleome*, *Corchorus*, *Sida* etc. The common grasses which sometimes cover a large area are: *Apluda mutica*, *Aristida adscensionis*, *Brachiaria ramosa*, *Chrysopogon fulvus*, *Cymbopogon martinii*, *Desmostachya bipinnata*, *Dichanthium annulatum*, *Echinochloa colona*, *Heteropogon contortus*, *Melanocenchris jacquemontii*, *Tetrapogon tenellus*, *Tragus roxburghii*, and species of *Cenchrus*, *Chloris*, *Eragrostis*, etc.

**2. Rocky- gravelly undulating plains:** Rocky- gravelly and undulating plains are quit common and are spread from Narayan Sarovar to Haman Khudi, Guhar, Kanoj, Sheh, Tahera, Halapar, Nareda, Vanyor and Baranda etc. The common trees and shrubs recorded here are almost the same as recorded on the hills, but they are very sparsely distributed. The thorny scrub type vegetation of these regions face a high biotic pressure, particularly the ground flora (after monsoon) as most of the livestock is grazing on these plains. A peculiar feature of this habitat was noted after 10 km of Narayan Sarovar along Haman Khudi, Nareda, Halapar via Baranda and Vanyor, where the entire area of rocky gravelly plains are covered with a homogeneous population of *Helichrysum cutchicum* which gives a terpentine like smell in the environment. A large purplish pink- flowered rare species of *Senera incana* was also recorded here. The common associations recorded in this habitat are:

- (i) *Acacia* with *Salvadora oleoides*, *S. persica*
- (ii) *Capparis decidua* with *Salvadora oleoides*, *Ziziphus nummularia*
- (iii) *Ziziphus nummularia* with *Prosopis juliflora*, *Acacia senegal*
- (iv) *Acacia senegal* with *Premna resinosa*, *Capparis decidua*, *Ziziphus nummularia*, *Salvadora oleoides*.

The common trees and shrubs of this habitat are: *Acacia senegal*, *A. eburnea*, *A. leucophloea*, *A. nilotica* ssp. *subalata*, *Capparis decidua*, *Cordia perrottetii*, *Commiphora wightii*, *Euphorbia caducifolia*, *Grewia tenax*, *Lycium barbarum*, *Premna resinosa*, *Prosopis juliflora*, *P. cineraria*, *Salvadora oleoides*, *S. persica*, *Ziziphus nummularia* etc. The ground flora is similar to hills.

The common climbers of this habitat are: *Asparagus racemosus*, *A. dumosus*, *Cadaba fruticosa*, *Dalechampia scandens* var. *cordofana*, *Ipomoea* spp., *Maerua oblongifolia*, *Mukia maderaspatana*, *Rivea hypocrateriformis*, *Rhynchosia minima* etc.

The undulating plains are very rich in grass species called as “Savannah” (grasslands). The common grasses are *Aristida* spp., *Cenchrus* spp., *Chloris* spp., *Dicanthium annulatum*, *Eragrostis* spp., *Panicum* spp., *Sporobolus* spp., *Melanocenchris jacquemontii*, *Tragus roxburghii*, *Tetrapogon tenellus* etc. Physiognomically, Sanctuary predominantly supports mixed scrub thorn forest (58%) and grasslands (savannah) (25%) types.

**3. Sandy hummocky plains with low sand dunes:** The western part of the Sanctuary, particularly from Narayan Sarovar to Haman Khudi, Lakki, Medi, Gangariana and in the east upto Lakhpat, is covered with sandy hummocky plains with low dunes. This habitat is also intermixed with rocky / gravelly plains and ends in mangrove forest.

The common trees and shrubs are: *Calotropis procera*, *Capparis decidua*, *Cordia perrottetii*, *Commiphora wightii*, *Lycium barbarum*, *Acacia leucophloea*, *Prosopis cineraria*, *Salvadora oleoides*, *S. persica*, *Ziziphus nummularia* etc. The common ephemerals and undershrubs forming a green carpet during moonson season are: *Aerva javanica*, *Borreria articularis*, *Boerhavia diffusa*, *Citrullus colocynthis*, *Corchorus depressus*, *Crotalaria burhia*, *Cucumis callosus*, *C. prophetarum*, *Enicostema axillare*, *Fagonia schweinfurthii*, *Gisekia pharnaceoides*, *Heliotropium zeylanicum*, *Hibiscus micranthus*, *Indigofera cordifolia*, *I. linnaei*, *Leptadenia pyrotechnica*, *Mollugo cerviana*, *Polygala erioptera*, *Pulicaria angustifolia*, *P. crispa*, *Seriscostoma pauciflora*, *Sida cordata*, *S. ovata*, *Solanum nigrum*, *Tribulus terrestris*, *Trichodesma amplexicaule* var. *indica*, *Vernonia cinerea*, *Withania somnifera* etc.

The common grasses and sedges recorded are: *Aristida* spp., *Cenchrus* spp., *Chloris* spp., *Dactyloctenium aegyptium*, *D. scindicum*, *Dichanthium annulatum*, *Ochthochloa compressa*, *Panicum antidotale*, *P. typheron*, *Sporobolus* spp., *Tetrapogon tenellus* etc. *Bolboschoenus maritimus*, *Cyperus conglomerates*, *Cyperus difformis*, *C. iria*, *C. rotundus*, *Eleocharis geniculata*, *Fimbristylis bisumbellata*, *Schoenoplectus roylei* etc are the common sedges recorded here. Lactiferous *Periploca aphylla* climbs on the clumps of bushes in association with *Rhynchosia minima*.

The common associations recorded in this psammophytic habitat are:

- (i) *Capparis decidua* with *Salvadora oleoides* and *Ziziphus nummularia*
- (ii) *Aerva javanica* with *Crotalaria burhia* and *Leptadenia pyrotechnica*
- (iii) *Ziziphus nummularia* with *Prosopis juliflora* and *Acacia leucophloea*
- (iv) *Cenchrus ciliaris* with *C. biflorus*, *C. setigerus*, *Aristida* spp. and *Eragrostis tremula*.

**4. Western Coastal Mangrove and saline habitat:** The sandy hummocky and saline plains, which ultimately end in mangrove and muddy rann are common from Lakki to Medi. The common species recorded from saline habitat are: *Ammannia baccifera*, *Artiplex stocksii*, *Bergia ammannioides*, *Cressa cretica*, *Glinus lotoides*, *Heliotropium curassavicum*, *H. ovalifolium*, *Eclipta prostrata*, *Blumea obliqua*, *Polygonum plebium*, *Suaeda fruticosa*, *Tamarix* spp., *Trianthema portulacastrum* and *Zygophyllum simplex* etc. Sedges and grasses are poorly represented in these habitats, like *Scirpus tuberosus*, *Aeluropus lagopoides*, *Sporobolus* spp., *Urochondra setulosa* etc in association with *Ochthochloa compressa*.

The coastal area of Kachchh is surrounded on the south by the Gulf of Kachchh and on the west by the Arabian Sea. The coastal region in the west of Narayan Sarovar WLS rises gently and is fringed with mangrove swamps from Lakki to Kori Creek. Xerophytic and salt tolerant species are the characteristic feature of this mangrove forest, and dominating species having climatic climax is *Avicennia marina*, which reaches upto Pakistan border (Kori Creek). *Heliotropium ovalifolium*, *Peganum harmala* var. *stenophylla*, *Scaveola taccada* and *Tamarix* spp., are the other common elements of the permanent vegetation of mangrove forest. At tidal creeks, *Avicennia marina* associated with a grass species of *Urochondra setulosa* forms a dense association.

**5. Marshy / Aquatic habitat:** There is no perennial river in the Sanctuary; Guhar dam is the only permanent water source used for irrigation as well as drinking purposes. Though, the Sanctuary has eight water bodies located at Haman Khudi, Pipar, Halapar, Mindhiari, Narayan Sarovar, Godhatal and Suvar, but excepting Guhar dam all are ephemeral and have water only for few months after the rains. In relation to the substratum, water and air, the hydrophytes of the Sanctuary may be grouped into following life forms.

- i. Rooted with floating leaves: *Potamogeton nodosus*.
- ii. Attached submerged: *Vallisneria spiralis* var. *denseserrulata*.
- iii. Suspended submerged: *Najas minor*.
- iv. Amphibious emerged: *Typha domingensis*, *Bolboschoenus maritimus*.

v. Marshy: The common plants of marshy habitat are: *Alternanthera sessilis*, *Ammannia baccifera*, *Bacopa monnieri*, *Bergia ammannioides*, *Blumea* spp., *Coldenia procumbens*, *Eclipta prostrata*, *Grangea*

*maderaspatana*, *Heliotropium ovalifolium*, *Phyla nodiflora*, *Polygonum plebeium*, *Vernonia cinerea* etc. The sedges like *Bolboschoenus maritimus*, *Cyperus pygmaeus*, *C. rotundus*, *Schoenoplectus roylei* etc. and grasses like *Echinochloa colona*, *Eragrostis ciliaris* var. *brachystachya* etc.

**6. Weeds:** Several characteristic weedy species forms a considerable part of the Sanctuary in association with seasonal crops, fallow fields and in wastelands. Maximum weeds are noted in rainy season in comparison to winter or summer season. The common winter season weeds with 'Rabi' crop are: *Celosia argentea*, *Chenopodium album*, *C. murale*, *Euphorbia hirta*, *Fagonia schweinfurthii*, *Polycarpaea corymbosa* etc. The common grass species associated with these are: *Dactyloctenium aegyptium*, *Eragrostis tremula* etc.

The weed species associated with summer crops are *Alhagi maurorum*, *Crotalaria burhia*, *Solanum nigrum*, *Tribulus terrestris*, *Withania somnifera* and *Ziziphus nummularia* etc.

Due to more humus and moisture contents during rainy season, maximum weed species are recorded, sometimes forming a pure population and lush green carpet in fallow fields and wastelands. The common rainy season weeds associated with 'Kharif' crop are: *Achyranthes aspera*, *Alternanthera sessilis*, *Aristolochia bracteolata*, *Boerhavia diffusa*, *Catharanthus pusillus*, *Celosia argentea*, *Cleome gynandra*, *C. viscosa*, *Commelina benghalensis*, *Corchorus trilocularis*, *Digera muricata*, *Euphorbia clarkeana*, *E. hirta*, *Gisekia pharanaceoides*, *Heliotropium maurifolium* var. *wallichii*, *H. strigosum*, *Indigofera hochstetteri*, *I. linnaei*, *Kohautia aspera*, *Launaea procumbens*, *Mollugo cerviana*, *Nothosaerva brachiata*, *Hedyotis corymbosa* var. *linearis*, *Pulicaria angustifolia*, *Phyllanthus fraternus*, *P. maderaspatana*, *Physalis divaricata*, *Portulaca oleracea*, *Sida cordifolia*, *S. ovata*, *Spermacoce hispida*, *S. pusilla*, *Tephrosia purpurea*, *Trianthema portulacastrum*, *Trichodesma indica* var. *amplexicaule*, *Vernonia cinerea*, *Withania somnifera* etc. The common grasses competing with the crops in rainy season are: *Aristida adscensionis*, *Cenchrus biflorus*, *C. ciliaris*, *C. setigerus*, *Chloris* spp., *Dactyloctenium aegyptium*, *D. scindicum*, *Desmostachya bipinnata*, *Dichanthium annulatum*, *Echinochloa colona*, *Eragrostis* spp., *Ochthochloa compressa*, *Tetrapogon tenellus* etc. *Cyperus rotundus* is the only sedge showing its presence with these grasses.

#### SYNOPSIS OF THE FLORA

In the present work 455 indigenous and naturalized species belonging to 247 genera under 74 families have been enumerated. (Table 2)

Table 2: Synopsis of the flora.

Taxonomic group	Families		Genera		Species	
	No.	%	No.	%	No.	%
ANGIOSPERMS						
Dicotyledons	64	85.49	193	78.14	354	77.80
Monocotyledons	9	12.16	53	21.46	100	21.98
GYMNOSPERMS						
	1	1.35	1	0.40	1	0.22
TOTAL	74	100.00	247	100.00	455	100.00

The phytodiversity of the Sanctuary shows that, among the dicotyledons, the class Polypetale dominates and represented by 177 species (38.99%) belonging to 95 genera and 36 families. Fabaceae is the largest family with 42 species and Malvaceae occupies second place with 21 species in Polypetalae. Gamopetalae finds second place and represented by 130 species (38.63%), 73 genera and 20 families. Convolvulaceae is the largest family with 22 species in gamopetalae followed by Asteraceae and Boraginaceae with 19 and 17 species. The class Monochlamydeae is represented by 47 species (10.35%) belonging to 25 genera and 8 families. Amaranthaceae is the largest family in Monochlamydeae with 16 species, followed by Euphorbiaceae with 15 species.

Monocotyledon & shows poor representation in the Sanctuary with only 100 species (22.02%) belonging to 53 genera and 9 families. It is interesting to note that out of 100 species of monocots, Poaceae is represented with 66 species and Cyperaceae with 18 species; the other 7 families of monocots have only 16 species. Gymnosperm was represented by single taxa.

The ratio of species belonging to Monocotyledons to Dicotyledons is 1: 3.5, of genera 1: 3.6 and of families 1: 7.1. The ratio of total number of genera to species is 1: 1.84 which is rather low in comparison to the corresponding ratio for Flora of Gujarat which is about 1: 2.2 (Shah, 1978), 1: 2.3 (Pandey & Singh, 1999), 1: 2.4 (Singh & Parabia, 2003) and 1: 2.5 (Meena & Pandey, 2004), but it is about equal to the ratio for Flora of Kachchh 1: 1.8 (Thakar, 1926) and Flora of North Gujarat 1: 1.8 (Saxton & Sedgwick, 1918).

#### ECONOMIC POTENTIALITY OF PHYTODIVERSITY

The phytodiversity of the Sanctuary is quite rich in economic resources and many of them have potentiality to add to the economy of the State.

**Medicinal plants:** The therapeutic properties of plant have created wide interest among people to learn about plants and their parts, which may be used as a source for new drugs. The local inhabitants of the Sanctuary have acquired a deep knowledge in this field due to their long association with the local plants in the forests. Some important medicinal plants used by the inhabitants of Narayan Sarovar WLS for the treatment of various diseases are: *Abrus precatorius*, *Acacia nilotica* ssp. *indica*, *A. nilotica* ssp. *subalata*, *A. senegal*, *Achyranthes aspera*, *Aerva javanica*, *Amaranthus tricolor*, *A. viridis*, *Ammannia baccifera*, *Aristolochia bracteolata*, *Asparagus racemosus*, *Avicennia marina*, *Bacopa monnieri*, *Balanites aegyptiaca*, *Barleria prionitis*, *Bergia suffruticosa*, *Blepharis lineriaefolia*, *Boerhavia diffusa*, *Bombax ceiba*, *Cadaba fruticosa*, *Cajanus cajan*, *Calotropis procera*, *Capparis cartilaginea*, *C. decidua*, *Cardiospermum halicacabum*, *Cassia siamea*, *Catharanthus pusillus*, *Celosia argentea*, *Cenchrus setigerus*, *Chenopodium album*, *Citrullus colocynthis*, *C. lanatus*, *Clerodendrum phlomidis*, *Cleome brachycarpa*, *C. gynandra*, *C. viscosa*, *Clitoria ternatea*, *Coccinia grandis*, *Coldenia procumbens*, *Commiphora wightii*, *Convolvulus auricomus*, *Corchorus depressus*, *Cordia perrottetii*, *Cressa cretica*, *Crotalaria burhia*, *C. hebecarpa*, *Cucumis callosus*, *C. prophetarum*, *Cymbopogon martinii*, *Cyperus rotundus*, *Dactyloctenium aegyptium*, *D. scindicum*, *Datura metel*, *Desmostachya bipinnata*, *Echinochloa colona*, *Eclipta prostrata*, *Enicostema axillaris*, *Evolvulus alsinoides*, *Euphorbia caducifolia*, *E. hirta*, *Fagonia schweinfurthii*, *Ficus benghalensis*, *Gisekia pharnaceoides*, *Glinus lotoides*, *Grewia tenax*, *G. villosa*, *Helichrysum cutchicum*, *Indigofera cordifolia*, *I. oblongifolia*, *I. tinctoria*, *Ipomoea nil*, *I. pes-tigridis*, *Launaea procumbens*, *Lepidagathis trinervis*, *Leptadenia pyrotechnica*, *L. reticulata*, *Leucas cephalotes*, *L. urticaefolia*, *Luffa acutangula* var. *amara*, *Lumnitzera racemosa*, *Lycium barbarum*, *L. edgeworthii*, *Mimosa hamata*, *Momordica balsamina*, *Mukia maderaspatana*, *Ochthochloa compressa*, *Oxystelma esculenta*, *Panicum antidotale*, *P. trypheron*, *Pedaliium murex*, *Peganum harmala* var. *stenophylla*, *Pergularia daemia*, *Periploca aphylla*, *Peristrophe bicalyculata*, *Phyllanthus fraternus*, *Polygonum plebeium*, *Premna resinosa*, *Prosopis juliflora*, *P. cineraria*, *Pulicaria angustifolia*, *Rhynchosia minima*, *Rivea hypocrateriformis*, *Ricinus communis*, *Salvadora oleoides*, *S. persica*, *Salvia santolinaefolia*, *Scaevola taccada*, *Senna auriculata*, *Sida cordata*, *S. cordifolia*, *S. ovata*, *Solanum nigrum*, *Suaeda fruticosa*, *Taverniera cuneifolia*, *Tephrosia purpurea*, *Teramnus labialis*, *Thespesia populnea*, *Trianthema portulacastrum*, *Tribulus terrestris*, *Vernonia cinerea*, *Withania somnifera*, *Ziziphus nummularia*, *Zygophyllum simplex*.

**Timber yielding plants:** Timber is most essential for the economic development of an area, which is used variously in the daily life of human beings. Some of the common timbers yielding plants of the Sanctuary are: *Acacia leucophloea*, *A. nilotica* subsp. *indica*, *A. nilotica* subsp. *subalata*, *A. senegal*, *Albizia lebbeck*, *Capparis decidua*, *C. grandis*, *Cassia siamea*, *Prosopis cineraria*, *P. juliflora*.

**Firewoods:** The woody plants used by villagers residing in the Sanctuary for firewood in their day-to-day life are: *Acacia leucophloea*, *A. nilotica* subsp. *indica*, *A. senegal*, *Aerva javanica*, *Capparis decidua*, *Commiphora wightii*, *Cordia dichotoma*, *Crotalaria burhia*, *Gossypium arboreum*, *Grewia tenax*, *Ficus* spp., *Leptadenia pyrotechnica*, *Prosopis juliflora*, *P. cineraria*, *Salvadora oleoides*, *S. persica*, *Senna auriculata*, *Ziziphus mauritiana*.



**Gum / Resin-yielding plants:** Some of the tree species yield gum / resin, which is used for various purposes, e.g. *Acacia leucophloea*, *A. nilotica* ssp. *indica*, *A. nilotica* ssp. *subalata*, *A. senegal*, *Commiphora wightii*, *Prosopis cineraria*, *P. juliflora*.

**Tannin yielding plants:** The common tannin yielding plants are: *Acacia leucophloea*, *A. nilotica* ssp. *indica*, *A. nilotica* ssp. *subalata*, *Avicennia marina*, *Senna auriculata* and *Ziziphus mauritiana*.

**Dye yielding plants:** The common dye yielding plants are: *Abrus precatorius*, *Acacia nilotica* ssp. *indica*, *A. senegal*, *Achyranthes aspera*, *Eclipta prostrata*, *Indigofera tinctoria*, *Peganum harmala* var. *stenophylla*, *Phyllanthus fraternus*, *Prosopis juliflora*, *Senna auriculata*.

**Fiber-yielding plants:** Some of the common fiber yielding plants are: *Acacia leucophloea*, *A. nilotica* ssp. *indica*, *A. nilotica* ssp. *subalata*, *Bombax ceiba*, *Calotropis procera*, *Cordia dichotoma*, *C. perrotetii*, *Corchorus olitorius*, *Crotalaria burhia*, *Desmostachya bipinnata*, *Ficus benghalensis*, *Gossypium arboreum*, *Leptadenia pyrotechnica*, *L. reticulata*, *Ochthochloa compressa*, *Pergularia daemia*, *Phragmites karka*, *Saccharum bengalense*, *Senna auriculata*, *Sida cordata*, *S. ovata*, *S. rhomboidea*, *Typha angustata*.

**Edible fruits:** Usually edible fruits are obtained from plants grown in orchards. But, local people use a number of wild plants species for their edible value, viz. *Acacia nilotica* ssp. *indica*, *Acacia senegal*, *Aegle marmelos*, *Asparagus racemosus*, *Capparis decidua*, *Citrullus colocynthis*, *C. lanatus*, *Cucumis callosus*, *C. melo*, *Cordia gharaf*, *C. perrotetii*, *Ficus benghalensis*, *Grewia tenax*, *G. villosa*, *Leptadenia reticulata*, *Prosopis cineraria*, *Rhus mysorensis*, *Salvadora oleoides*, *S. persica*, *Solanum nigrum*, *Ziziphus nummularia*.

**Plants used as vegetable:** Common fresh green vegetables are hardly available to the local inhabitants living in the Sanctuary. Alternatively, some common species used as vegetable are: *Amaranthus tricolor*, *Capparis decidua*, *Chenopodium album*, *Coccinia grandis*, *Euphorbia caducifolia*, *Momordica balsamina*, *Portulaca oleracea*, *Suaeda fruticosa*, *Trianthema portulacastrum*.

**Oil yielding plants:** Seeds of many wild plant species yield edible or non edible oil, which is used in food, medicines, varnishes, paints, lubricants, beverages, soap, detergent and perfume industries. The important species whose seeds are the source of oil are: *Citrullus colocynthis*, *C. lanatus*, *Ricinus communis*, etc. Leaves of *Cymbopogon martinii* also yield volatile oil used in medicines.

**Fodder-yielding plants:** Grasses are the main source of fodders for livestock of the Sanctuary. After rainy season, a number of plant species come up and provide fodder, but during summer and winter only perennial species are the main sources of fodder, viz. *Acacia leucophloea*, *A. nilotica* ssp. *indica*, *A. nilotica* ssp. *subalata*, *A. senegal*, *Aeluropus lagopoides*, *Apluda mutica*, *Brachiaria ramosa*, *Cenchrus biflorus*, *C. ciliaris*, *C. setigerus*, *Chrysopogon fulvus*, *Clerodendrum phlomidis*, *Crotalaria burhia*, *Cymbopogon martinii*, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *D. scindicum*, *D. pertusum*, *Desmostachya bipinnata*, *Dichanthium annulatum*, *D. foveolatum*, *Dinebra retroflexa*, *Echinochloa colona*, *Eragrostis tenella*, *E. tremula*, *Gisekia pharnaceoides*, *Grewia tenax*, *Heteropogon contortus*, *Indigofera cordifolia*, *I. oblongifolia*, *Lycium edgeworthii*, *Ochthochloa compressa*, *Panicum antidotale*, *P. trypheron*, *Pennisetum typhoides*, *Phragmites karka*, *Prosopis cineraria*, *P. juliflora*, *Salvadora oleoides*, *S. persica*, *Setaria verticillata*, *Sporobolus ioclados*, *Tribulus terrestris*, *Zea mays*, *Ziziphus nummularia*.

**Plants used as famine food:** Famine is a common phenomenon in the entire district of Kachchh. The number of rainy days are very few, and sometimes there is no rain or occur only few showers, resulting in shortage of water, as such no cultivation and ultimately severe famine. In the shortage of food grains, the residents use a number of plants species for foods, viz. *Acacia senegal*, *Achyranthes aspera*, *Brachiaria ramosa*, *Capparis decidua*, *Citrullus colocynthis*, *C. lanatus*, *Cyperus rotundus*, *Cenchrus biflorus*, *C. setigerus*, *Dactyloctenium aegyptium*, *Grewia tenax*, *Indigofera cordifolia*, *Panicum antidotale*, *Prosopis cineraria*, *Salvadora oleoides*, *S. persica*, *Setaria verticillata*, *Tribulus terrestris*, *Ziziphus nummularia*.

Tender twigs of *Acacia nilotica* ssp. *nilotica*, *Ficus benghalensis*, *Senna auriculata* etc are the alternative source of toothbrush.

Some of the plant species may be exploited commercially and may add a new source of revenue for the State Government. Some of these species are: *Calotropis procera*, *Aerva javanica* (fibers & stuffing materials), *Capparis decidua* (pickles), *Acacia senegal*, *Commiphora wightii* (gum & resin), *Citrullus colocynthis* (non - edible oil), *Balanites aegyptica* (medicines), *Avicennia marina*, *Senna auriculata* (tannin).

#### WILD RELATIVES OF CULTIVATED PLANTS

The present day cultivated plants have evolved from their wild relatives, which are still of considerable importance for the improvement of crops and other useful cultivated plants. In India, about 323 wild relative species of cultivated plants have been recorded so far (Arora & Nair, 1985). Recently 116 wild relatives of 64 cultivated plants have been recorded from Gujarat (Pandey & Padhye, 2000). Present study reveals that quite a considerable numbers of wild relatives of cultivated plants grow in Narayan Sarovar WLS, which are tabulated below.

Crop/ cultivated plants with Chromosome nos.	Wild relative & related species with chromosome nos.
Cereals & Millets:	
<i>Eleusine coracana</i> (36,37,38,39,43)	<i>Ochthochloa compressa</i>
Leguminous plants:	
<i>Vigna dalzellina</i> (22)	<i>Vigna aconitifolia</i> (22,44)
<i>Vigna radiata</i> (22,23,24,44)	<i>Vigna trilobata</i> (22,24)
Fruit plants:	
<i>Citrullus lanatus</i> (22)	<i>Citrullus colocyntis</i> (22,24,44)
<i>Cordia dichotoma</i>	<i>Cordia gharaf</i> (72)
<i>Grewia asiatica</i> (36)	<i>Grewia tiliacifolia</i> (18)
<i>Ziziphus mauritiana</i> (48)	<i>Ziziphus nummularia</i> (24,40,48,72)
Vegetable crop plants:	
<i>Luffa acutangula</i> (26,52)	<i>Luffa acutangula</i> var. <i>amara</i>
<i>Momordica charantia</i> (22)	<i>Momordica balsamina</i> (22)
<i>Portulaca pilosa</i> ssp. <i>grandiflora</i> (10,18,36)	<i>Portulaca oleracea</i> (14,18,36,45)
<i>Solanum melongena</i> (24,36,48)	<i>Solanum incanum</i> (24)
Fiber yielding plants:	
<i>Corchorus capsularis</i> (8,14,16,28)	<i>Corchorus olitorius</i> (7,14,28,35) &
<i>Corchorus trilocularis</i> (14)	
Miscellaneous:	
<i>Physalis peruviana</i> (24,28)	<i>Physalis minima</i> (48,72)

#### ENDEMIC, RARE AND THREATENED TAXA AND THEIR CONSERVATION

Pandey & Singh (1999) listed 16 species of endemic plants confined to Gujarat State. Shah (1983) reported 61 species, Nayar & Shastri (1988) & WCMC (1994) recorded 47 taxa, Singh & Parabha (2003) enlisted 51 and Meena & Pandey (2004) reported 76 species of endemic, rare and threatened plants from Gujarat. Recently, Gujarat Ecological Society (2003) published a booklet on rare and endangered plants and animals of Gujarat, reported 39 plant species as rare and endangered to Gujarat. Out of this, 22 species are

reported from different parts of Kachchh. Parmar & Singh (2003) added five more species to this work, of which three are endemic to India, one is rare and one species new to India. Sabnis & Rao (1983) enumerated a list of 13 plants from Kachchh, whereas Rao (1981) and Bhatt (1993) reported 35 and 7 species in their thesis on flora of South- Eastern & flora of western Kachchh respectively. Present study revealed that out of 16 endemic species from Gujarat (Pandey & Singh, *l.c.*), 4 species are represented in Narayan Sarovar WLS, viz. *Tamarix kachchhensis*, *T. stricta* and *Viola cinerea* var. *stocksii* and *Helichrysum cutchicum*.

The floral diversity of Narayan Sarovar WLS is facing different degrees of threats due to heavy biotic pressure and high demand of natural produce. Further, in and around areas of the Sanctuary harbour rich mineral deposits, particularly for cement and lignite industries. As such, mining also produces an adverse impact on the ecosystem. The endemic, rare and threatened plants recorded from Narayan Sarovar WLS are given below:

**Endemic plants:**

*Helichrysum cutchicum* (Asteraceae)

*Tamarix kachchhensis* (Tamaricaceae)

*Tamarix stricta* (Tamaricaceae)

*Viola cinerea* var. *stocksii* (Violaceae)

**Rare & Threatened plants:**

*Abelmoschus tuberculatus* var. *deltoidefolia* (Malvaceae)

*Aeluropus lagopoides* (Poaceae)

*Camphylanthus ramosissimus* (Scrophulariaceae)

*Capparis cartilaginea* (Capparaceae)

*Citrullus colocynthis* (Cucurbitaceae)

*Cleome simplicifolia* (Cleomaceae)

*Commiphora wightii* (Burseraceae)

*Convolvulus auricomus* var. *volubilis* (Convolvulaceae)

*Convolvulus stocksii* (Convolvulaceae)

*Cyperus rotundus* var. *centiflora* (Cyperaceae)

*Dactyliandra welwitschii* (Cucurbitaceae)

*Dalechampia scandens* var. *codofana* (Euphorbiaceae)

*Ephedra foliata* (Gnetaceae)

*Heliotropium bacciferum* var. *suberosum* (Boraginaceae)

*Heliotropium bacciferum* var. *tuberculatum* (Boraginaceae)

*Heliotropium rariflorum* (Boraginaceae)

*Heliotropium tuberosum* (Boraginaceae)

*Indigofera caerulea* var. *monosperma* (Fabaceae)

*Ipomoea kotschyana* (Convolvulaceae)

*Limonium stocksii* (Plumbaginaceae)

*Merremia rajasthanensis* (Convolvulaceae)

*Oxystelma esculenta* (Asclepiadaceae)

*Periploca aphylla* (Periplocaceae)  
*Premna resinosa* (Verbenaceae)  
*Pycneus flavidus* var. *strictus* (Cyperaceae)  
*Scaevola taccada* (Goodeniaceae)  
*Senra incana* (Malvaceae)  
*Solanum elaeagnifolium* (Solanaceae)  
*Stylosanthis fruticosum* (Fabaceae)  
*Taverniera cuneifolia* (Fabaceae)  
*Taverniera glabra* (Fabaceae)  
*Tephrosia pentaphylla* (Fabaceae)  
*T. uniflora* ssp. *petrosa* (Fabaceae)  
*Tribulus rajasthanensis* (Zygophyllaceae)  
*Urochondra setulosa* (Poaceae)

The importance of phytodiversity of an area is determined by the presence of rare threatened and endemic taxa. It is proved in terms of a small area of about 436.8 sq km; Narayan Sarovar WLS sustains 39 species out of about 75 rare threatened and endemic species of Gujarat State. As these species grow in small-scattered patches with thin population, biotic pressure, over grazing, human interference and mining activities may adversely affect their existence. Therefore, immediate measures need to be taken to control these activities in the Sanctuary; otherwise the day is not far away when they will become extinct from the nature.

#### **Conservation methods:**

The endemic, rare and threatened plants represent a small but an important part of the flora. They are very susceptible to the effect of environmental change, because they occur in small population or at scattered localities and are confined to unique and localized habitat. Biotic activities, such as land clearing, cutting, over-grazing, development of monoculture forest etc cause inadequate reproductive mechanism, inviability of seeds and lower the range of adaptation, resulting in dwindling of plant taxa. Therefore, immediate scientific measures need to be taken to conserve such germplasm in *in-situ* and *ex-situ* conditions. Some of the conservation methods effective to conserve biodiversity are:

1. Maximum afforestation and after care in *in situ* condition.
2. Use of advanced bio-technics for multiplication of such species, like tissue culture etc.
3. Habitat protection/ conservation.
4. Germplasm of depleting species may be preserved in seed bank.
5. Sustainable use of economically important species.
6. People's participation in conservation programme.
7. People's awareness and education for nature conservation.

Besides this, the research alone cannot help to restore the biodiversity loss unless there is a will, awareness and involvement of local people in conservation programme. Thanks to Government of Gujarat who is very particular in this subject and creating awareness among the people and educating them for the reaching implications of ecological degradation

#### **RECOMMENDATIONS**

The present study also supports the guidelines provided for the management of Narayan Sarovar WLS (Annon., 2001). The major themes of guidelines broadly cover the zoning of the Sanctuary, biodiversity

conservation, eco-development measures, eco-tourism and mitigation of potential threats from future economic activities. The following are the recommendations.

1. Measures to conserve rare and endangered species of flora and fauna.
2. Creation of two mini core areas- Two zones viz. 'Pipar' and 'Mindhiari' (Rakhals), due to their rich floral and faunal assemblage, covering an area of about 18000 hectares.
3. Preservation of corridor areas- In view of future mining activities, 'Godhatal' zone is considered as very critical for wildlife movement, suggested as an important corridor zone.
4. Eco-tourism- Due to its close proximity to the famous temples of Narayan Sarovar and Koteswar, 'Halapar zone' is suggested for development of eco-tourism.
5. In order to develop some multiple use areas, two buffer areas need to be identified in the eastern and western parts of the Sanctuary.
6. Improvement of water availability and vegetation cover management under habitat improvement programme is suggested.
7. Measures need to be taken to control biotic pressure.
8. Regulatory protection is the necessity of the Sanctuary.
9. Shifting of mineral (lignite, limestone and bentonite) and cement industries and thermal power station.
10. Removal of fast spreading species of *Prosopis juliflora*.
11. People's awareness and education for nature conservation.

Thus ecologically Narayan Sarovar is an important unit as it falls under a separate biotic province of the Indian desert and have a distinct 'gene pool'. It also supports the remaining patches of "Desert thorn forest" in the country. Abundance of 'Savanna' (grassland)- a typical habitat of arid regions, and coastal habitat (Mangroves) in association of the above, form a unique ecological matrix and home for several rare and endangered fauna and flora (Annon., 2001). Thus, Narayan Sarovar WLS is a paradise for floral and faunal diversity of this unique ecological zone.

#### FAUNAL DIVERSITY

The faunal diversity of Narayan Sarovar WLS may be grouped into three major groups:

- (i) Herpeto fauna (Amphibian & Reptiles)
- (ii) Avi fauna (Birds) and
- (iii) Mammals

Among these the common ones are: \*Spiny tailed lizard, \*\* Indian Chamaeleon, Red Sand boa, Black Cobra, Spectacle Cobra, \*\* Checkered Keel Back Snake, Common Trinket Snake, Saw Scaled Viper, Frogs, Tods, Lesser spotted Eagle, Jungle Cat, Desert Cat, Caracal, Ratel or Honey Badger, Indian Percupine, Chinkara or Indian Gazelle, Nilgai or Blue Bull, Small Indian Civet, Small Indian Mongoose, Grey Wolf, Golden Jackal, Common Fox, Desert Fox, Striped Haeyna, Rufous Tailed Hare, Indian Pangolin and Leopard ( not now ). It is also very interesting to note that some of the animals marked with \*(Schedule – I) and \*\* (Schedule- II) are threatened upto IUCN status. Thus, the faunal diversity of the sanctuary is also very rich in the area (Annon. 2001).

#### ENUMERATION

##### MENISPERMACEAE

\**Coculus hirsutus* (L.) W. Theob. "Vevidi, Vadhi no vevlo, Vagvai".

\**Coculus pendulus* (J.R. & G. Forst.) Diels, "Ordad, Value, Parwatti".

## BRASSICACEAE

\***Brassica rapa** L. var. **campestris** (L.) A.R. Clapham, “*Sarsav*”.

## CLEOMACEAE

**Cleome gynandra** L. “*Talavasi*”.

Common in moist sandy gravelly soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar nani, *V. Singh* 15814 (BSJO); Sandrovadh R. F., *R. P. Pandey* 20003 (BSJO); Narayan Sarovar, *R.P. Pandey* 20019 (BSJO).

\***Cleome scaposa** DC.

**Cleome simplicifolia** (Camb.) Hook.f. & Thomson, “*Roto bidhro, Ratirai, Sanunbidhro*”.

Rare along stream in moist rocky habitat.

*Fl. & Fr.*: Oct.- Dec.

Mindhiari R.F., *R. P. Pandey* 13979 (BSJO).

**Cleome vahliana** Fresen.

Common in open rocky gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Narayan Sarovar, *R.S. Raghavan* 114912 (BSI), *R.P. Pandey* 13993, *V. Singh* 15918 (BSJO); Baranada, *R.P. Pandey* 19871 (BSJO).

**Cleome viscosa** L. “*Pilitalavani*”.

Common in open places in sandy-loam to gravelly soil.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15785; *R. P. Pandey* 17754 (BSJO); Nareda, *R. P. Pandey* 19882 (BSJO).

## CAPPARACEAE

**Cadaba fruticosa** (L.) Druce, “*Taliokand, Jangli Mirchi, Karopijoro*”.

Common woody climber on hedges and in scrub jungle in rocky gravelly or sandy habitat.

*Fl. & Fr.*: Oct.- Jan.

Narayan Sarovar, *R.S. Raghavan* 114631, 114943 (BSI); Sinapur along Lakhat, *R.P. Pandey* 14000 (BSJO); Mindhiari R.F., *V. Singh* 15856 (BSJO).

**Capparis cartilaginea** Decne. “*Parbatral*”.

Rare on old walls and rocky habitat.

*Fl. & Fr.*: July- Feb.

Narayan Sarovar temple and on wall of old building near tank, *R.P. Pandey* 19840, 13991, 19840 (BSJO); Kanno, *V. Singh* 15981 (BSJO).

*Uses*: Fruits are cooked as vegetable and squirrels eat the pulp of the fruit.

**Capparis decidua** (Forssk.) Edgew. “*Kerdo*”.

Common in open sandy gravelly habitat.

*Fl. & Fr.*: Almost throughout the year.

Mindhiari R.F., *V. Singh* 15852 (BSJO); Guhar village, *R.P. Pandey* 17744 (BSJO); Guhar moti, *R.P. Pandey* 19866 (BSJO).

**Capparis grandis** L. f. "*Dumrejo jad, Ghuti*".

Common in protected forest, on hills.

*Fl. & Fr.*: Dec.- May.

Mota Dhola Rakhal, S.K. Jain 61902 (BSI).

**\*Capparis sepiaria** L. "*Kanthar*".**\*Capparis spinosa** L. "*Kanthar*".

## VIOLACEAE

**Viola cinerea** Boiss. var. **stocksii** (Boiss.) W. Becker

Rare in moist gravelly habitat.

*Fl. & Fr.*: July- Oct.

Haman Khudi, V. Singh 15915 (BSJO).

## POLYGALACEAE

**Polygala erioptera** DC. "*Patsan, Bhoisan*".

Common in gravelly-loamy plains.

*Fl. & Fr.*: Oct.- Dec.

Watch tower, Halapar. R.P. Pandey 13944 (BSJO); Guhar dam, R.P. Pandey 17792 (BSJO); Mindhiari R.F., V. Singh 15742 (BSJO).

**Polygala persicariaefolia** DC. "*Rati Bhoidan*".

Rare in moist gravelly habitat.

*Fl. & Fr.*: During Monsoon season.

Haman Khudi, V. Singh 15927 (BSJO).

**\*Polygala polifolia** Presl, "*Pili bhonsysan, Perpatsan*".

## CARYOPHYLLACEAE

**Polycarpea corymbosa** (L.) Lam. "*Jangli suwa, Rupakuli*".

Common weed in the forest.

*Fl. & Fr.*: Aug.- Feb.

Guhar nani, V. Singh 15832 (BSJO).

**\*Polygala spicate** Wight & Arn. "*Fulchhogaro*".**\*Spergula arvensis** L.

## PORTULACACEAE

**Portulaca oleracea** L. "*Lakha Luni, Kutabo, Moti Luni*".

Common along stream in moist, rocky loamy habitat.

*Fl. & Fr.*: Oct.- Dec.

Narayan Sarovar, V. Singh 15802, R.P. Pandey 20014 (BSJO); Mindhiari, R.F., R. P. Pandey 13966 (BSJO).

**Portulaca pilosa** L. "*Rati Luni, Varandhyun*".

Fairly common in moist sandy-loam soil.

*Fl. & Fr.*: July- Nov.

Guhar, *R.P. Pandey* 19844 (BSJO).

\***Portulaca quadrifida** L. "*Zini luni*".

#### TAMARICACEAE

**Tamarix ericoides** Rottler & Willd.

Common in moist saline habitat.

*Fl. & Fr.*: Aug.- Mar.

Narayan Sarovar, *R.S. Raghavan* 114649 (BSI).

**Tamarix indica** Willd. "*Laijo Jad, Lai; Ratilai, Jhav, Tavuka*".

Common in saline habitat.

*Fl. & Fr.*: Aug.- Dec.

Kannoj, *V. Singh* 15977 (BSJO).

**Tamarix kachchensis** B.V. Shetty & R.P. Pandey

Frequently found along sea-coast in moist clayey soil.

*Fl. & Fr.*: Oct.- Jan.

Narayan Sarovar tank side, *R.P. Pandey* 13901 (BSJO).

#### ELATINACEAE

**Bergia ammannioides** Roxb. ex Roth, "*Jal ukharan, Jal Okharan*".

Common in moist places.

*Fl. & Fr.*: Aug.- Oct.

Mindhiari R.F., *V. Singh* 15887 (BSJO).

\***Bergia capensis** L. "*Jal Jamavo*".

**Bergia suffruticosa** (Delile) Fenzl. "*Ropatiri, Gandharo Okhrad, Vithi Kharsan*".

Common in moist places.

*Fl. & Fr.*: Oct.- Dec.

Guhar tank, *R.P. Pandey* 17748 (BSJO); Kunri, *V. Singh* 15902 (BSJO).

#### MALVACEAE

**Abelmoschus tuberculatus** Pal & Singh var. **deltoideifolia** T.K. Paul & Nayar

Rare in moist sandy gravelly habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 17717 (BSJO).

**Abutilon fruticosum** Guill. & Perr. "*Saneri dabliaar, Jhinki khapat*".

Common on low hills in rocky habitat.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari Rakhal R.F., *R.P. Pandey* 13970 (BSJO); Kannoj, *V. Singh* 15974 (BSJO).

\***Abutilon indicum** (L.) Sweet, "*Khapat*".



**Abutilon pannosum** (G. Forst. ) Schlecht. “ *Dabliaar, Daloli*”.

Common in rocky gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15739 (BSJO).

**Gossypium arboreum** L. “*Kapas*”.

Commonly cultivated as a crop.

*Fl. & Fr.*: Dec.- April.

Mota Dhora Rakhal, *S. K. Jain* 61898 (BSI).

**Hibiscus hirtus** L.

*Fl. & Fr.*: Oct.- March.

Frequently found in forest undergrowth.

Mori R.F., *V. Singh* 15991 (BSJO).

**Hibiscus lobatus** (Murray) Kuntze, “*Ranbhindi, Tali*”.

*Fl. & Fr.*: Aug.- Nov.

Common in gravelly moist soil.

Midhariari R.F., *V. Singh* 15774, 15883 (BSJO); Halapar, *V. Singh* 15950 (BSJO).

**Hibiscus micranthus** L. f. “*Furalvel, Chanbhindi, Adbawal*”.

Common on, low hills in rocky- gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Narayan Sarovar, *V. Singh* 15903A (BSJO).

**Hibiscus palmatus** Forssk.

Frequently found in gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Rodasar, *V. Singh* 15955 (BSJO).

**\*Pavonia arabica** Hochst & Steudel ex Boiss.**Pavonia glechomaefolia** (A. Rich.) Garcke ex Schweinf. “ *Dhatuvaljajad, Kathrotio, Adalia*”.

Rarely found in moist sandy-gravelly habitat.

*Fl. & Fr.*: Aug.- Dec.

Mori R.F., *V. Singh* 15988 (BSJO).

**Pavonia procumbens** (Wall. ex Wight & Arn.) Walp.

Not common in moist loamy soil.

*Fl. & Fr.*: Oct.- Dec.

Haman Khudi river bed, *R .P. Pandey* 13929 (BSJO); Mori R.F., *V. Singh* 15996 (BSJO).

**\*Pavonia zeylanica** (L.) Cav.**Senra incana** Cav.

Rare in open rocky-gravelly habitat.

*Fl. & Fr.*: Oct.- Dec.

Halapar along Nalia, *R.P. Pandey* 13931(BSJO); Haman Khudi, *V. Singh* 15925 (BSJO).

**Sida alba** L.

Common in open gravelly- loamy habitat.

*Fl. & Fr.*: Aug.- Dec.

Narayan Sarovar, *R.P. Pandey* 20018 (BSJO).

**Sida cordata** (Burm. f.) Borss. Walk. "*Pat Balbuvaro, Nindhi dhatuvel*".

Common in gravelly-loamy soil.

*Fl. & Fr.*: Oct.- Dec.

Haman Khudi, *R.P. Pandey* 13906, *V. Singh* 15917 (BSJO); Mindhiari R.F. , *V. Singh* 15774 A (BSJO).

**Sida cordifolia** L. "*Balbuvaro, Balbuvarejo Jad, Bala, Kharmonthi*".

Common in gravelly-loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15760 (BSJO).

**Sida ovata** Forssk.

Common in gravelly-loamy soil.

*Fl. & Fr.*: Oct.- Jan.

Along Guhar tank, *R.P. Pandey* 17736 (BSJO).

**Sida rhombifolia** L.

Frequently found in gravelly habitat.

*Fl. & Fr.*: Aug.- Dec.

Guhar nani, *V. Singh* 15842 (BSJO).

**Sida spinosa** L. "*Kandharo Babulvaro, Kantalo Bal, Kharanto*".

Rare in moist gravelly sandy soil.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15868 (BSJO).

**Thespesia populnea** (L.) Soland. ex Correa, "*Paras pipdo*".

Planted along roadsides in rocky loamy habitat.

*Fl. & Fr.*: Jan.- Dec.

Pavapar, along Nakatarana Narayan Sarovar road, *R.P. Pandey* 13985 (BSJO).

## BOMBACACEAE

**Bombax ceiba** L.

Occasionally seen in rocky habitat in the forest.

*Fl. & Fr.*: April- June.

Mota Dhola Rakhal, *S.K. Jain* 61894 (BSI).

## STERCULIACEAE

**\*Helicteres isora** L. "*Marad sing, Ati*".**Melhanian futteyporensis** Munro ex Master, "*Vagda Ukhapato, Adba Ukapat*"

Not common in rocky habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15752 (BSJO).

***Waltheria indica* L.**

Not common in rocky- gravelly habitat.

*Fl. & Fr.*: Aug.- Dec.

Miadhariari R.F., *V. Singh* 15796 (BSJO).

TILIACEAE

**\**Corchorus capsularis* L. “Borchuchni”.**

***Corchorus aestuans* L. “Kaggisodi, Kagkela”.**

Frequently found in moist loamy soil.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15705 (BSJO); Along river bed, near Haman Khudi, *R.P. Pandey* 13912 (BSJO).

***Corchorus depressus* (L.) Vicary, “Bahuphali, Munderi”.**

Common in gravelly- rocky habitat.

*Fl. & Fr.*: Sept.- Jan.

Guhar tank side, *R.P. Pandey* 17757 (BSJO); Guhar nani, *V. Singh* 15840 (BSJO).

***Corchorus olitorius* L. “Kargisodo, Gunpatjojad”.**

Common in open places, in moist rocky- loamy soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13978, *V. Singh* 15703 (BSJO).

***Corchorus trilocularis* L. “Ubhimundheri, Lambi Chunch, Kadui Chunchdi”.**

Common in gravelly rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi, *R.P. Pandey* 13902 (BSJO); Mindhiari R.F., *V. Singh* 15726, 15880 (BSJO).

**\**Grewia abutilifolia* Vent. ex A. Juss.**

***Grewia tenax* (Forssk.) Fiori, “Gangeti”.**

Common on hills, in rocky habitat.

*Fl. & Fr.*: Sept.- Jan.

Kunri, R.F., *V. Singh* 15903 (BSJO); Guhar nani, *V. Singh* 15808 (BSJO); Halapar, *R.P. Pandey* 13935 (BSJO); Kuriani, *R.P. Pandey* 20027 (BSJO); Haman Khudi, *R.P. Pandey* 19853 (BSJO).

***Grewia tiliifolia* Vahl**

Occasionally found in scrub forest.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15732 (BSJO).

***Grewia villosa* Willd.**

Common on hills in rocky habitat.

*Fl. & Fr.*: Oct.- Jan.

Mindhiari R.F., *R.P. Pandey* 13967 (BSJO); Barania, *R. P. Pandey* 19874 (BSJO).

**Melochia corchorifolia** L.

Frequently found in gravelly habitat.

*Fl. & Fr.*: Aug.- Jan.

Halapar R.F., *V. Singh* 15945 (BSJO).

**Triumfetta malabarica** Koen. ex Rottlb. "*Jibto, Bhurato, Berbhunt*".

Common in scrub forest.

*Fl. & Fr.*: Aug.- Dec.

Mori R.F., *V. Singh* 15993 (BSJO).

ZYGOPHYLLACEAE

**Fagonia indica** Burm. f. "*Dhamaso*".

Common in rocky- gravelly plains.

*Fl. & Fr.*: Oct.- Jan.

Along Guhar village, *R.P. Pandey* 17738 (BSJO); Junachar river, *R.P. Pandey* 12104 (BSJO).

**Fagonia schweinfurthii** (Hadidi) Hadidi

Common in gravelly- loamy soil.

*Fl. & Fr.*: Sept.- Jan.

Nalia, *R.P. Pandey* 17726 (BSJO); Near watchtower, Halapar, *R.P. Pandey* 13942 (BSJO); Guhar nani, *V. Singh* 15841 (BSJO).

**Tribulus rajasthanensis** Bhandari & B.D. Sharma

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar tank & Guhar village, *R.P. Pandey* 17749, 17770 (BSJO); Mindhiari R.F., *V. Singh* 15740, 15757 (BSJO).

**Tribulus terrestris** L. "*Gokhru*".

Common in gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *V. Singh* 15820 (BSJO).

**Zygophyllum simplex** L. "*Patlani, Atheli, Alethi*".

Not common in loamy habitat.

*Fl. & Fr.*: Aug. - Dec.

Kunri R.F., *V. Singh* 15899 (BSJO); Kanno, *V. Singh* 15982 (BSJO).

OXALIDACEAE

**\*Biophytum sensitivum** (L.) DC. "*Risamnu, Zarero*".

GERANIACEAE

**Monsonia senegalensis** Guill. & Perr.

Rare in open gravelly sandy habitat.

*Fl. & Fr.*: July - Nov.

Haman Khudi, *R.P. Pandey* 19848 (BSJO).

#### BALANITACEAE

\***Balanites roxburghii** Planch. "*Ingorio, Hingirio*".

#### BURSERACEAE

**Commiphora wightii** (Arn.) Bhandari, "*Gugar, Mitho Gugod*".

Common in sandy- gravelly- rocky habitat.

*Fl. & Fr.*: After rainy season.

Kunri R.F., *V. Singh* 15913 (BSJO); Tera village, *R.P. Pandey* 17775 (BSJO); Mindhiari Rakhal R.F., *R.P. Pandey* 20008 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114917 (BSI).

#### MELIACEAE

\***Azadirachta indica** A. Juss. "*Limdo*".

\***Melia azedarach** L. *Bakani nim*".

#### CELASTRACEAE

\***Maytenus senegalensis** (Lam.) Exell. "*Vico, Vickro*".

#### RHAMNACEAE

\***Ziziphus mauritiana** Lam. "*Bor, Bordi*".

**Ziziphus nummularia** (Burm. f.) Wight & Arn. "*Chaniabor*".

Common throughout, in mixed habitat.

*Fl. & Fr.*: Oct.- Dec.

Sheh, *V. Singh* 15969 (BSJO); Mindhiari R.F., *R.P. Pandey* 13957 (BSJO); Junachar hills, *R.P. Pandey* 12105 (BSJO).

#### SAPINDACEAE

**Cardiospermum halicacabum** L. "*Tridhari vel, Velfolti, Bakanfofli*".

Common in rocky and gravelly-loamy habitat.

*Fl. & Fr.*: Oct.- Dec.

Mindhiari R.F., *R.P. Pandey* 13969, *V. Singh* 15744 (BSJO); Nareda- along Nalia Road, *R.P. Pandey* 13948 (BSJO).

#### MORINGACEAE

\***Moringa oleifera** Lam. "*Saragvo*".

#### FABACEAE

\***Abrus precatorius** L. "*Chanothi*".

**Aeschynomene indica** L. "*Patagdodi*".

Frequently found in moist habitat.

*Fl. & Fr.*: Aug.- Jan.

Halapar R.F., *V. Singh* 15944 (BSJO).

**Alysicarpus hamosus** Edgew.

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar, *R.P. Pandey* 17760 (BSJO).

***Alysicarpus longifolius*** (Rottler & Spreng.) Wight & Arn. "*Vedo samervo, Ghodo samervo*".

Common among grasses in wastelands and in hedges.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15753, 15866 (BSJO).

***Alysicarpus tetragonolobus*** Edgew.

Common among grasses.

*Fl. & Fr.*: Aug.- Nov.

Mindhiari R.F., *V. Singh* 15891 (BSJO).

***Alysicarpus vaginalis*** (L.) DC. "*Pat samervo, Ridh samervo*".

Common in moist sandy- gravelly habitat.

*Fl. & Fr.*: July- Dec.

Mindhiari R.F., *V. Singh* 15863 (BSJO).

\****Arachis hypogaea*** L. "*Mugfali*" (Cultivated).

\****Butea monosperma*** (Lam.) Taub. "*Kesurdo, Khakhro*".

\****Cajanus platycarpus*** (Benth.) Maesen

***Clitoria ternatea*** L. "*Ganeli*".

Not common in moist loamy soil.

*Fl. & Fr.*: Oct.- Jan.

Haman Khudi river, *R.P. Pandey* 13913 (BSJO); Mori R.F., *V. Singh* 15995 (BSJO).

***Crotalaria burhia*** Buch.-Ham. ex Benth. "*Khadsan, Sangetro*".

Common in sandy- hummocky plains.

*Fl. & Fr.*: Oct.- Jan.

Sinapar, along Lakhpat, *R.P. Pandey* 13998 (BSJO); Kunri R.F., *V. Singh* 15912 (BSJO).

***Crotalaria hebecarpa*** (DC.) Rudd

Common in moist rocky- loamy habitat along stream.

*Fl. & Fr.*: Oct.- Dec.

Mindhiari R.F., *R.P. Pandey* 13972, *V. Singh* 15745 (BSJO).

***Crotalaria medicaginea*** Lam. "*Mirio, Untmirio, Ran methi*".

Common in sandy- gravelly habitat.

*Fl. & Fr.*: Aug.- Feb.

Mindhiari R.F., *V. Singh* 15754 (BSJO).

***Crotalaria mysorensis*** Roth

Frequently found in open grassland.

*Fl. & Fr.*: Aug.- Jan.

Mindhiari R.F., *V. Singh* 15876 (BSJO).

**Crotalaria orixensis** Willd.

Rarely found among grasses.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F. *V. Singh* 15873 (BSJO).

**\*Cyamopsis teteragonoloba** (L.) Taub. "*Guwar, Gawar*".**Indigofera caerulea** Roxb. var. **monosperma** Santapau

Rare in sandy- gravelly habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15731 (BSJO).

**Indigofera cordifolia** Heyne ex Roth

Common throughout, in sandy- loam soil.

*Fl. & Fr.*: Aug.- Dec.

Guhar, *R.P. Pandey* 17759(BSJO); Nareda, *R.P. Pandey* 19879 (BSJO); Mindhiari R.F., *V. Singh* 15723 (BSJO).

**Indigofera glandulosa** Willd. "*Vekerio*".

Very common in open sandy-loam habitat.

*Fl. & Fr.*: July- Nov.

Guhar, *R.P. Pandey* 19846 (BSJO).

**Indigofera hochstetteri** Baker, "*Bethi Gali*".

Common in sandy moist habitat.

*Fl. & Fr.*: Sept.- Dec.

Along Guhar, *R.P. Pandey* 17753, 17773 (BSJO); Mindhiari R.F., *R.P. Pandey* 13973, *V. Singh* 15708, 15778 (BSJO).

**\*Indigofera linifolia** (L.f.) Retz. var. **campbellii** Wight ex Baker**Indigofera linnaei** Ali, "*Patgali, Bhoynkali, Jinkigali*".

Common in sandy- loam soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar, *R.P. Pandey* 17765 (BSJO); Guhar nani, *V. Singh* 15822 (BSJO).

**Indigofera oblongifolia** Forssk. "*Zil, Ziladi, Zilado*".

Common in sandy- loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Narayan Sarovar forest, *W.J. Stower*, Acc. No. 33002 (BSI); Guhar nani, *V. Singh* 15827 (BSJO).

**Indigofera tinctoria** L. "*Gudi, Nil, Garijo jad*".

Common in rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13982, *V. Singh* 15769 (BSJO).

**Rhynchosia minima** (L.) DC. "*Dariavel*".

Common herbaceous climber, in moist rocky- gravelly and loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi river, *R.P. Pandey* 13917 (BSJO); Mindhiari R.F., *V. Singh* 15712, 15743 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114923 (BSI).

**Sesbania bispinosa** (Jacq.) Wight, "*Ikad*".

Common weed in moist places.

*Fl. & Fr.*: Aug.- Feb.

Mindhiari R.F., *V. Singh* 15721 (BSJO).

**\*Sesbania sesban** (L.) Merr.**Stylosanthes fruticosa** (Retz.) Alston

Common in open gravelly-loamy habitat.

*Fl. & Fr.*: Sept.- Jan.

Along Narayan Sarovar tank, *R.P. Pandey* 17732, 20013 (BSJO); Guhar nani, *V. Singh* 15843 (BSJO).

**Taverniera cuneifolia** (Roth) Arn.

Rarely found in gravelly habitat.

*Fl. & Fr.*: Aug.- Oct.

Halapar, R.F., *V. Singh* 15952 (BSJO).

**Taverniera glabra** Boiss.

Rare in gravelly sandy habitat.

*Fl. & Fr.*: Sept.- Jan.

Sheh, *V. Singh* 15971 (BSJO).

**Tephrosia leptostachya** DC.

Not common in gravelly habitat.

*Fl. & Fr.*: Aug.- Dec.

Guhar nani, *V. Singh* 15813 (BSJO).

**Taverniera pentaphylla** (Roxb.) G. Don

Rare in gravelly sandy habitat.

*Fl. & Fr.*: Sept.- Nov.

Mindhiari R.F., *V. Singh* 15871 (BSJO).

**\*Taverniera purpurea** (L.) Pers. "*Sarpankho*".**Taverniera strigosa** (Dalzell) Santapau & Mahesh

Common on low hillocks, in rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Along Narayan Sarovar tank, *R.P. Pandey* 17733 (BSJO); Mindhiari R.F., *V. Singh* 15936 (BSJO).

**Taverniera tinctoria** (L.) Pers.

Common in open loamy habitat.



*Fl. & Fr.*: Sept.- Jan.

Near Beta village, *R.P. Pandey* 17711 (BSJO).

**Taverniera uniflora** Pers. subsp. **petrosa** (Blatt. & Hallb.) Gillette & Ali

Rare in sandy- loamy habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15777 (BSJO); Mori R.F. 15992 (BSJO).

**Teramnus labialis** (L. f.) Spreng. "*Adad vel, Rambhval singriyaar*".

Common on hedges and low shrubs in sandy- loamy soil.

*Fl. & Fr.*: After rainy season.

Narayan Sarovar, *V. Singh* 15807 (BSJO).

**Teramnus mollis** Benth. "*Runchal singriyaar*".

Common climbing or trailing herbs on undershrubs.

*Fl. & Fr.*: After rainy season.

Mori R.F., *V. Singh* 19586 (BSJO).

**Vigna aconitifolia** (Jacq.) Marechal, "*Math*".

Common in open moist places in rocky loamy soil.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *R.P. Pandey* 13976 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114936 A (BSI).

**Vigna mungo** (L.) Hepper var. **sublobata** B.D. Sharma

Frequent, in loamy soil.

*Fl. & Fr.*: July - Dec.

Mindhiari R.F., *V. Singh* 15851 (BSJO).

\***Vigna radiata** (L.) Wilczek, "*Mug*" (Cultivated).

**Vigna trilobata** (L.) Verdc.

Common in moist loamy habitat.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *V. Singh* 15755 (BSJO).

#### CAESALPINIACEAE

\***Caesalpinia bonduc** (L.) Roxb.

**Cassia siamea** Lam.

Planted along roadside.

*Fl. & Fr.*: Almost throughout the year.

Ravapar, *R.P. Pandey* 13986 (BSJO).

**Chamaecrista pumila** (Lam.) V. Singh

Common in moist rocky- loamy habitat.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *V. Singh* 15728, 15758 (BSJO); Kanno, *V. Singh* 15980 (BSJO).

**\*Piliostigma malabarica** (Roxb.) Benth.

**Senna auriculata** (L.) Roxb. "*Aval*".

Fairly common in rocky habitat.

*Fl. & Fr.*: Sept.- Jan.

Nalia, along Jakhu, *R.P. Pandey* 17725 (BSJO).

**Senna italica** Mill.

Frequently found in wastelands in moist sandy- gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15776 (BSJO).

**Senna obtusifolia** (L.) Irwin & Barneby

Common, along roadsides and undergrowth of forest in loamy soil.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15765, 15879 (BSJO).

**Senna occidentalis** (L.) Link

Common in sandy-loam soil.

*Fl. & Fr.*: Almost throughout the year.

Mindhiari R.F., *V. Singh* 15791 (BSJO).

**Senna tora** (L.) Roxb.

Common in moist sandy soil.

*Fl. & Fr.*: Oct.- Feb.

Along Guhar, *R.P. Pandey* 17750 (BSJO).

**\*Tamarindus indicus** L. "*Amlī*".

MIMOSACEAE

**Acacia bivenosa** DC.

Commonly planted in gravelly-loamy soil.

*Fl. & Fr.*: Oct.- Jan.

Forest plantation, Halapar, *R.P. Pandey* 13939 (BSJO).

**Acacia leucophloea** (Roxb.) Willd. "*Harmo baval*".

Common in rocky habitat on hills.

*Fl. & Fr.*: Oct.- Mar.

Mata Na Math R.F., *R.P. Pandey* 13988 (BSJO).

**Acacia nilotica** (L.) Willd. ex Del. subsp. **indica** (Benth.) Brenan

Common in loamy- sandy soil.

*Fl. & Fr.*: Almost throughout the year.

Sheh, *V. Singh* 15966 (BSJO).

**Acacia nilotica** (L.) Willd. ex Del. subsp. **subalata** (Vatke) Brenan, "*Baval*".

Common in sandy gravelly habitat and on hills.

*Fl. & Fr.*: Oct.- Mar.

Guhar, *R.P. Pandey* 17746 (BSJO).

**Acacia senegal** (L.) Willd. “*Goradio – baval*”.

Common on hills and in hummocky plains in rocky gravelly habitat.

*Fl. & Fr.*: Sept.- Feb.

Mata Na Math R.F., *R.P. Pandey* 17730 (BSJO); Haman Khudi river, *R.P. Pandey* 13923 (BSJO); Mindhiari R.F., *V. Singh* 15853 (BSJO).

\***Acacia tortilis** (Forssk.) Heyne var. **raddiana** (Savi) Brenan

**Albizia lebbeck** Benth. “*Shirish*”.

Commonly planted along roadsides and near habitations.

*Fl. & Fr.*: Mar.- June.

Nalia, *R.S. Raghavan* 114968 (BSI); Mata Na Math R.F., *R.P. Pandey* 13989 (BSJO).

\***Dichrostachya cinerea** (L.) Wight & Arn. var. **indica** Brenan & Brummit. “*Mor Dhun-dhiyu*”.

**Mimosa hamata** Willd.

Common, along valley in moist rocky habitat.

*Fl. & Fr.*: Oct.- June.

Mindhiari R.F., *R.P. Pandey* 13954 (BSJO); Jadava, *R.P. Pandey* 19888, *V. Singh* 15733 (BSJO).

\***Mimosa pudica** L. “*Kasi, Kaibava*”.

**Neptunia triquetra** Benth.

Occasional, in moist clayey soil.

*Fl. & Fr.*: Sept.- Feb.

Narayan Sarovar, *R.S. Raghavan* 114919 (BSI).

\***Pithecellobium dulce** (Roxb.) Benth. “*Goras amlī*” (Planted).

\***Prosopis cineraria** (L.) Druce, “*Khijado*”.

**Prosopis juliflora** (Sw.) DC. “*Gando – baval*”.

Common throughout in mixed habitat.

*Fl. & Fr.*: Oct.- Mar.

Mindhiari R.F., *V. Singh* 15855 (BSJO); Guhar village, *R.P. Pandey* 17745 (BSJO).

#### COMBRETACEAE

**Lumnitzera racemosa** Willd.

Not common in mangrove swamps.

*Fl. & Fr.*: Dec.- Apr.

Lakki mangrove forest, *R.P. Pandey*, 177744-A (BSJO).

**Terminalia catappa** L.

Planted, in sandy- loam soil.

*Fl. & Fr.*: Oct.- Mar.

Narayan Sarovar Rest house, *R.P. Pandey* 17743, 20020 (BSJO).

## MYRTACEAE

\***Eucalyptus hybrida** Maiden, “*Nilgiri*” (Planted).

## LYTHRACEAE

**Ammannia baccifera** L.

Common throughout in marshy habitat.

*Fl. & Fr.*: Sept.- Mar.

Nalia, R.S. *Raghavan* 114982 (BSI); Mindhiari R.F., *V. Singh* 15735,15892 (BSJO).

**Ammannia multiflora** Roxb.

Common in moist habitat.

*Fl. & Fr.*: Aug.- Nov.

Mindhiari R.F., *V. Singh* 15897 (BSJO).

\***Lawsonia inermis** L. “*Mendhi*” (Planted).

## CUCURBITACEAE

**Citrullus colocynthis** (L.) Schard. “*Tumbo*”.

Common weed in waste places.

*Fl. & Fr.*: Aug.- Dec.

Guhar nani, *V. Singh* 15828 (BSJO).

**Citrullus lanatus** (Thunb.) Matsum. & Nakai, “*Matiro, Kharbujo*”.

Escape from cultivation in waste places.

*Fl. & Fr.*: July- Nov.

Kannoj, *V. Singh* 15983 (BSJO).

**Coccinia grandis** (L.) Voigt, “*Tindora*”.

Common climber on trees and shrubs near habitations.

*Fl. & Fr.*: Almost throughout the year particularly after rains.

Kannoj, *V. Singh* 15973 (BSJO); Narayan Sarovar, *V. Singh* 15806 (BSJO); Baranda, *R.P. Pandey* 19872 (BSJO).

**Corallocarpus epigaeus** (Rottl. & Willd.) Benth. & Hook.f.

Common on hedges and in scrub jungle in rocky habitat.

*Fl. & Fr.*: Oct.- Dec.

Mata Na Math R.F., *R.P. Pandey* 13990 (BSJO); Mindiyari Rakhal R.F., *R.P. Pandey* 20009 (BSJO).

**Ctenolepis cerasiformis** (Stocks) Hook.f.

Common climbing herbs on trees in moist places.

*Fl. & Fr.*: Aug.- Dec.

Halapar R.F., *V. Singh* 15942 (BSJO).

**Ctenolepis garcinii** (Burm. f.) Naud.

Common climber on *Prosopis juliflora* in moist sandy-loam soil.

*Fl. & Fr.*: Oct.- Jan.

Haman Khudi, *R.P. Pandey* 13916 (BSJO).

**Cucumis callosus** (Rottler) Cogn.

Common weed in waste places and in cultivated fields.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15702 (BSJO).

**Cucumis prophetarum** L. "*Aldri*".

Common in moist gravelly soil.

*Fl. & Fr.*: Oct.- Jan.

Guhar dam, *R.P. Pandey* 17782 (BSJO); Moti chheralong, Lakhpat, *R.P. Pandey* 20022 (BSJO); Mindhiari R.F., *V. Singh* 15781, 15875 (BSJO).

**Dactyliandra welwitschii** Hook. f.

Common climbing herb on hedges.

*Fl. & Fr.*: Aug.- Dec.

Guhar nani dam, *V. Singh* 15837 (BSJO); Sandrovadh R.F., *R.P. Pandey* 19900 (BSJO).

**Luffa acutangula** (L.) Roxb. var. **amara** (Roxb.) C.B. Clarke, "*Kadvi - Tori*".

Common a climbing herb on trees and shrubs in moist loamy places.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *V. Singh* 15706, 15730 (BSJO); Haman Khudi river, *R.P. Pandey* 13924 (BSJO).

**Momordica balsamina** L.

Not common found on hedges after rains.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *V. Singh* 15784 (BSJO).

**Mukia maderaspatana** (L.) Roem.

Common climber on hedges in rocky habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *R.P. Pandey* 13971, *V. Singh* 15767 (BSJO).

## CACTACEAE

**\*Opuntia elatior** Mill. "*Phaphdo thor*".

## AIZOACEAE

**Trianthema portulacastrum** L. "*Satodi*".

Common weed in moist loamy soil.

*Fl. & Fr.*: July - Nov.

Mindhiari R.F., *V. Singh* 15797 (BSJO); Haman Khudi, *R.P. Pandey* 19896, 19899 (BSJO).

**Trianthema triquetra** Rottler ex Willd.

Not common in moist rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15850, *R.P. Pandey* 13962 (BSJO); Haman Khudi river, *R.P. Pandey* 13919 (BSJO); By the side of Narayan Sarovar, *R.P. Pandey* 13995 (BSJO).

**Zaleya govindia** (Buch.- Ham. ex G. Don) Nair

Common in moist loamy- clayey soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15751 (BSJO); By the side of Narayan Sarovar, *R.P. Pandey* 13997 (BSJO); Guhar moti, *R.P. Pandey* 19862 (BSJO).

## MOLLUGINACEAE

**Gisekia pharnaceoides** L.

Not common in sandy soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar, *R.P. Pandey* 19843 (BSJO); Guhar nani, *R.P. Pandey* 17778, *V. Singh* 15824 (BSJO); Narayan Sarovar, *V. Singh* 15803 (BSJO).

**Glinus lotoides** L.

Common in drying moist grounds.

*Fl. & Fr.*: Almost throughout the year.

Narayan Sarovar, *V. Singh* 15801 (BSJO).

**Mollugo cerviana** (L.) Ser.

Common in moist gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

River near Haman Khudi, *R.P. Pandey* 13911(BSJO); Guhar nani, *R.P. Pandey* 17720 (BSJO).

## APIACEAE

\***Cuminum cyminum** L. “*Jiru*” (Cultivated).

\***Foeniculum vulgare** Mill. “*Valiari*” (Cultivated).

## RUBIACEAE

\***Catunareguam spinosa** (Thunb.) Tirvengadam, “*Mindhal, Medhelo*”.

**Hedyotis corymbosa** (L.) Lam. var. **linearis** (DC.) Deb & Dutta

Common weed in cultivated fields.

*Fl. & Fr.*: Sept.- Dec.

Guhar nani, *R.P. Pandey* 17779 (BSJO).

**Hedyotis puberula** (G. Don) Arn.

Rare in moist sandy- loam soil.

*Fl. & Fr.*: Oct.- Dec.

Mori R.F., *V. Singh* 15987 (BSJO); Mindhiari R.F., *V. Singh* 15864 (BSJO).

**Kohautia aspera** (Heyne ex Roth) Bremek.

Occasional, in moist sandy soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar nani, *R.P. Pandey* 17761; Haman Khudi, *V. Singh* 15928 (BSJO).

**Spermacoce articularis** L. f. “*Gantiyeli*”.

Not common in moist loamy soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R. F., *V. Singh* 15780 (BSJO); Haman Khudi, *R.P. Pandey* 13908 (BSJO).

**\*Spermacoce pusilla** Wall.

#### ASTERACEAE

**Blainvillea acmella** (L.) Philipson

Frequently found in gravelly- loamy habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15720 (BSJO).

**Blumea obliqua** (L.) Druce

Not common in moist loamy habitat.

*Fl. & Fr.*: Aug.- Nov.

Haman Khudi, *V. Singh* 15916 (BSJO); Mindhiari R.F., *V. Singh* 15845 (BSJO).

**\*Conyza stricta** Willd.

**Eclipta prostrata** (L.) L. "*Bhangaro*".

Common in marshy habitat.

*Fl. & Fr.*: Sept.- Jan.

Guhar dam, *R.P. Pandey* 17790 (BSJO).

**Gnaphalium luteo-album** L. subsp. **affine** (D. Don) Koster

Common in moist gravelly- loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Halapar, near watchtower, *R.P. Pandey* 13940 (BSJO).

**Garangea maderaspatana** (L.) Poir.

Common in moist sandy- loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15865 (BSJO).

**Helichrysum cutchicum** (C.B.Clarke) R.S. Rao & Deshp.

Common in sandy to clayey-gravelly habitat.

*Fl. & Fr.*: Sept.- Mar.

Haman Khudi, *V. Singh* 15921 (BSJO); Narayan Sarovar, *R.S. Raghavan*. 114920 (BSI).

**Lagera aurita** (L. f.) Sch.-Bip. ex C.B.Clarke

Very common in gravelly- rocky habitat.

*Fl. & Fr.*: Sept.- Jan.

Halapar, *R.P. Pandey* 13930, 13932 (BSJO).

**Launaea procumbens** (Roxb.) Rammayya & Rajgopal, "*Bhonpatri*".

Common in sandy- loam habitat.

*Fl. & Fr.*: Aug.- Dec.

Haman Khudi, *V. Singh* 15935 (BSJO).

**Launaea sarmentosa** (Will.) Alst.

Common along sea-coast and in riverbeds.

*Fl. & Fr.*: Almost throughout the year.

Kannoj, *V. Singh* 15976 (BSJO).

**Launaea resedifolia** (L.) Kuntze

Not common in moist sandy-loam habitat.

*Fl. & Fr.*: Aug.- Nov.

Mindhiari R.F., *V. Singh* 15763 (BSJO).

**Oligochaeta ramosa** (Roxb.) Wagenitz

Common in gravelly habitat.

*Fl. & Fr.*: Oct.- Jan.

Guhar nani, *V. Singh* 15839, *R.P. Pandey* 17740 (BSJO).

**Pluchea arguta** Boiss.

Common in saline habitat.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi, *V. Singh* 15926 (BSJO).

**Pluchea tomentosa** DC.

Rare in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Mori R.F., *V. Singh* 15990 (BSJO).

**Pulicaria angustifolia** DC.

Common in forest undergrowth in rocky places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13977, *V. Singh* 15725 (BSJO); Kunri R.F., *V. Singh* 15907 (BSJO).

**Pulicaria wightiana** (DC.) C.B. Clarke

Occasional, among grasses, in sandy-loam soil.

*Fl. & Fr.*: Aug.- Dec.

Sheh, *V. Singh* 15970 (BSJO).

**\*Sonchus asper** (L.) Hill.**\*Tridax procumbens** L. "*Pardesi bhangro*".**\*Vernonia cinerascens** Sch.-Bip.**Vernonia cinerea** (L.) Less. "*Sidoi*".

Common along stream in gravelly- loamy to moist rocky habitat.

*Fl. & Fr.*: Almost throughout the year.

Mindhiari Rakhal R.F., *V. Singh* 15718, *R.P. Pandey* 13980 (BSJO); Haman Khudi, *R.P. Pandey* 13905 (BSJO); Jadava, *R.P. Pandey* 19869 (BSJO).



## PLUMBAGINACEAE

\***Plumbago zeylanica** L. “*Chitrak*”.

## SAPOTACEAE

\***Manilkara hexandra** (Roxb.) Dub. “*Rayan*”.

## GOODNIACEAE

**Scaevola taccada** (Gaertn.) Roxb. “*Rudraksh*”.

Rare along sea-coast.

*Fl. & Fr.*: Aug. - Nov.

Haman Khudi, *V. Singh* 15941 (BSJO); Narayan Sarovar, *R. P. Pandey* 20031 (BSJO).

## SALVADORACEAE

**Salvadora oleoides** Decne, “*Jal*”.

Common in gravelly- rocky habitat.

*Fl. & Fr.*: Dec.- April.

Bhonar hills, *R.P. Pandey* 12103 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114932 (BSI).

**Salvadora persica** L. “*Jal, Pillo, Piludi*”.

Fairly common in loamy soil.

*Fl. & Fr.*: Oct.- Dec.

Narayan Sarovar, *R.P. Pandey* 13996 (BSJO).

## APOCYNACEAE

**Catharanthus pusillus** (Murr.) G. Don, “*Sadabahar*”.

Not common in rocky loamy soil.

*Fl. & Fr.*: Oct.- Jan.

Mindhiari R.F., *R.P. Pandey* 13965 (BSJO); Sandrovadh, *R.P. Pandey* 20001 (BSJO).

## ASCLEPIADACEAE

\***Calotropis gigantea** (L.) R. Br.

**Calotropis procera** (Ait.) Ait. f.

Common in open places in sandy- loam soil.

*Fl. & Fr.*: Almost throughout the year.

Guhar nani, *V. Singh* 15809 (BSJO); Haman Khudi river, *R.P. Pandey* 13927 (BSJO).

**Leptadenia pyrotechnica** (Forssk.) Decne.

Common in sandy places.

*Fl. & Fr.*: Aug.- Dec.

Guhar nani, *V. Singh* 15830 (BSJO); Guhar dam, *R.P. Pandey* 17794 (BSJO).

**Lalotropis reticulata** (Retz.) Wight & Arn. “*Mithidodi*”.

Common twinner of the area, in sandy habitat.

*Fl. & Fr.*: July- Mar.

Guhar Moti, *R.P. Pandey* 19865 (BSJO).

**Oxystelma esculenta** (L.f.) R. Br.

Not common twining herb on hedges in sandy- loam soil.

*Fl. & Fr.*: Aug.- Oct.

Mindhiari Rakhal R.F., *V. Singh* 15884 (BSJO).

**\*Pentatropis capensis** (L.f.) Bullock, “*Dudheli*”.**Pentatropis nivalis** (Gmel.) Field & Wood. “*Mithidodi*”.

Common on hedges in sandy- loam soil.

*Fl. & Fr.*: Aug.- Dec.

Sheh, *V. Singh* 15967 (BSJO); Guhar nani, *V. Singh* 15800 (BSJO).

**Pergularia daemia** (Forssk.) Chiov.

Common climbing herbs on trees and shrubs in moist loamy habitat.

*Fl. & Fr.*: Oct.- Jan.

Haman Khudi River, *R.P. Pandey* 13914 (BSJO); Mindhiari R.F., *V. Singh* 15709; *R.P. Pandey* 13952 (BSJO).

**\*Sarcostemma viminalis** (L.) R. Br. “*Son*”.**\*Telosma cordata** (Burm.f.) Merr.**\*Wattakaka volubilis** (L.f.) Stapf

## PERIPLOCACEAE

**\*Hemidesmus indicus** (L.) R. Br. “*Dudivel, Uplsari, Sariva, Anat mul*”.**Periploca aphylla** Decne. “*Dudhi - bel*”.

Common among bushes, in rocky- gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi, *V. Singh* 15933 (BSJO); Halapar, near watch tower, *R.P. Pandey* 13941 (BSJO); Nani chher, *R.P. Pandey* 20030 (BSJO); Narayan Sarovar, *R.S. Raghavan* 144933 (BSI).

## GENTIANACEAE

**Enicostema axillare** (Lam.) Raynal, “*Mamejao*”.

Common in moist sandy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari Rakhal R.F., *V. Singh* 15722, *R.P. Pandey* 13968 (BSJO); Guhar dam, *R.P. Pandey* 17787 (BSJO); Guhar moti, *R.P. Pandey* 19864 (BSJO).

## BORAGINACEAE

**Coldenia procumbens** L.

Common in moist sandy- loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15857, 15878 (BSJO).

**Heliotropium bacciferum** Forssk.

Common in sandy- loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *V. Singh* 15821(BSJO); Sandrovadh, R.F., *R.P. Pandey* 20007(BSJO); Narayan Sarovar, *R.P. Pandey* 20016 (BSJO).

**Heliotropium bacciferum** Forssk. subsp. **suberosum** (C.B.Clarke) Bhandari

Very common in gravelly- loamy habitat.

*Fl. & Fr.*: Sept.- Apr.

Guhar nani, *V. Singh* 15826 (BSJO); On the way to Koteswar temple, *R.P. Pandey* 121061 (BSJO).

**Heliotropium curassavicum** L.

Common in saline and moist clayey habitat.

*Fl. & Fr.*: Sept.- Dec.

Narayan Sarovar tank side, *R.P. Pandey* 13994 (BSJO).

**\*Heliotropium marifolium** Retz. var. **marifolium**, “Zinku Okharad”.

**Heliotropium marifolium** Retz. var. **wallichii** C.B.Clarke

Common in sandy- loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *R.P. Pandey* 17755 (BSJO).

**Heliotropium ophioglossum** Stock ex Aitch.

Rare in gravelly to loamy soil.

*Fl. & Fr.*: Sept.- Dec.

Nareda, *R.P. Pandey* 19884 (BSJO); Narayan Sarovar, *R.S. Raghavan* 194934 (BSI).

**Heliotropium ovalifolium** Forssk.

Common in dried up tank in clayey soil.

*Fl. & Fr.*: Oct.- Jan.

Mata Na Math, *R.P. Pandey* 13987 (BSJO); Kannoj, *V. Singh* 15979 (BSJO); Mindhiari R.F., *V. Singh* 15862 (BSJO).

**Heliotropium rariflorum** Stocks

Frequent, in sandy- loam soil.

*Fl. & Fr.*: Aug.- Nov.

Mindhiari R.F., *V. Singh* 15799 (BSJO).

**Heliotropium strigosum** Willd.

Common in moist places in sandy- loam soil.

*Fl. & Fr.*: Aug.- Dec.

Haman Khudi, *V. Singh* 15939 (BSJO).

**Heliotropium subulatum** (Hochst. ex DC.) Vatke

Common in sandy - gravelly habitat.

*Fl. & Fr.*: Oct.- Jan.

Guhar nani village, *R.P. Pandey* 17765, 17785(BSJO); *V. Singh* 15815 (BSJO).

**Heliotropium tuberosum** Boiss.

Not common in sandy gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Narayan Sarovar, *R.S. Raghavan* 114927 (BSI).

***Heliotropium zeylanicum* (Burm.f.) Lam.**

Fairly Common in open gravelly- loamy soil.

*Fl. & Fr.*: July- Nov.

Nareda, *R.P. Pandey* 19881 (BSJO).

***Sericostoma pauciflorum* Stocks ex Wight**

Common on hummocky plains in sandy habitat.

*Fl. & Fr.*: Oct.- Jan.

Guhar dam, *R.P. Pandey* 17795 (BSJO); Way to Lakhpat, *R.P. Pandey* 12107 (BSJO); Sinapar, along Lakhpat, *R.P. Pandey* 13999 (BSJO); Haman Khudi, *R.P. Pandey* 19858 (BSJO).

***Trichodesma indica* (L.) R. Br.**

Common in sandy- loam to gravelly habitat.

*Fl. & Fr.*: Sept.- Apr.

Narayan Sarovar, *R.S. Raghavan* 114910-A (BSI).

***Trichodesma indica* (L.) R. Br. var. *amplexicaule* (Roth) T. Cooke**

Common in sandy- loam soil.

*Fl. & Fr.*: Sept.- Apr.

Mindhiari Rakhil R.F., *V. Singh* 15711,15768,15881, (BSJO).

***Trichodesma inaequale* Edgew.**

Not common in sandy- loam habitat.

*Fl. & Fr.*: July- Nov.

Nareda, *R.P. Pandey* 19878 (BSJO).

EHRETIACEAE

***Cordia dichotoma* Forst. f.**

Planted, in sandy- loam soil.

*Fl. & Fr.*: Jan.- May.

Narayan Sarovar, *R.S. Raghavan* 114937 (BSI).

***Cordia gharaf* (Forssk.) Ehrenb. ex Asch.**

Common in sandy- gravelly soil.

*Fl. & Fr.*: Oct.- May.

Haman Khudi, *R.P. Pandey* 19854 (BSJO); Nalia, *R.S. Raghavan* 114969 (BSI).

***Cordia perrottetii* Wight, “Gundo”.**

Common on hills, in rocky habitat.

*Fl. & Fr.*: Jan.- May.

Mindhiari R.F., *R.P. Pandey* 13984 (BSJO).

## CONVOLVULACEAE

**Cressa cretica** L. “*Khariyu*”.

Fairly common in marshy saline habitat.

*Fl. & Fr.*: Sept.- Mar.

Near Lakhi Mangrove, *R.P. Pandey* 17796 (BSJO); Kunri R.F., *V. Singh* 15898 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114944 (BSI).

**Convolvulus auricomus** (A. Rich.) Bhandari

Not common in rocky- loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13958 (BSJO).

**Convolvulus auricomus** (A. Rich.) Bhandari var. **volubilis** (C.B. Clarke) Bhandari

Not common in loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15795 (BSJO).

**\*Convolvulus prostratus** Forssk. “*Shankhavli, Mankhni*”.**Convolvulus rhynospermus** Hochst. ex Choisy

Fairly common in gravelly- loamy soil.

*Fl. & Fr.*: Sept.- Dec.

Narayan Sarovar, along Nalia, *R.P. Pandey* 17731 (BSJO); Guhar nani, *V. Singh* 15823, 15838 (BSJO); Rodasar, *V. Singh* 15962 (BSJO).

**Convolvulus stocksii** Boiss.

Common in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari, *V. Singh* 15715, 15749 (BSJO).

**Evolvulus alsinoides** (L.) L. “*Shankhapuspi, Vishnugandhi*”.

Common among grasses, in sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari Rakhal R.F., *V. Singh* 15715-A; Kunri, *V. Singh* 15900 (BSJO).

**Hewittia subulata** (L. f.) Kuntze

Frequent, on hedges in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15750 (BSJO).

**Ipomoea carica** (L.) Sweet

Common herbaceous climber on *Prosopis juliflora*, in moist loamy soil.

*Fl. & Fr.*: Oct.- Dec.

Haman Khudi River, *R.P. Pandey* 13921 (BSJO).

**Ipomoea eriocarpa** R. Br.

Common among grasses in sandy-loam soil.

*Fl. & Fr.*: After rainy season.

Rodasar, *V. Singh* 15956 (BSJO).

***Ipomoea kotschyana*** Hochst. ex Choisy

Rare in sandy-loam soil.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15783 (BSJO).

***Ipomoea nil*** (L.) Roth, "*Krishnabija*".

Frequent, in scrub jungle.

*Fl. & Fr.*: Sept.- Dec.

Halapar R.F., *V. Singh* 15943 (BSJO); Mindhiari R.F., *R.P. Pandey* 13974 (BSJO).

***Ipomoea pes-caprae*** (L.) R. Br.

Common herbaceous twinner in open moist places, in gravelly-loamy soil.

*Fl. & Fr.*: Sept.- Jan.

Along Narayan Sarovar road from Nakhtarana, *R.P. Pandey* 17728 (BSJO).

***Ipomoea pes-tigridis*** L.

Common on hedges in wastelands.

*Fl. & Fr.*: Sept.- Dec.

Kunri R.F., *V. Singh* 15908 (BSJO).

***Ipomoea sindica*** Stapf

Common creeper, in moist loamy soil.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi river, *R.P. Pandey* 13920 (BSJO); Mindhiari R.F., *V. Singh* 15746, 15885 (BSJO).

***Ipomoea tuberculata*** Ker-Gawl.

Common in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mori R.F., *V. Singh* 15985 (BSJO).

***Ipomoea verticillata*** Forssk.

Not common in rocky habitat.

*Fl. & Fr.*: Sept.- Nov.

Mindhiari R.F., *R.P. Pandey* 13955 (BSJO).

**\**Merremia aegyptia*** (L.) Urban, "*Panch pan ni fudardi*".

***Merremia rajasthanensis*** Bhandari

Climbing herbs on hedges and trees in loamy soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15748 (BSJO).

***Rivea hypocrateriformis*** (Desr.) Choisy

Common climber on hedges and trees, in moist gravelly-loamy soil.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi River, *R.P. Pandey* 13926 (BSJO); Mindhiari R.F., *V. Singh* 15738 (BSJO).

**\*Seddera latifolia** Hochsl. & Steud.

**Xenostegia tridentata** (L.) Austin & Staples, "*Prasarni*".

Fairly common in open places in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Kunri R.F., *V. Singh* 15910 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114911 (BSI).

#### CUSCUTACEAE

**Cuscuta campestris** Yunker

Common parasite on hedges.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15861 (BSJO).

#### SOLANACEAE

**Datura fastuosa** L. "*Dhaturo*".

Common in dried up tanks and waste places in moist clayey soil.

*Fl. & Fr.*: Sept.- Jan.

Narayan Sarovar tank side, *R.P. Pandey* 13992 (BSJO).

**Datura innoxia** Mill. "*Dhaturo, Kalo dathuro*".

Not common in clayey- loam soil.

*Fl. & Fr.*: Sept.- Jan.

Near Koteswar temple, *R.P. Pandey* 13950 (BSJO).

**Lycium barbarum** L.

Common in sandy habitat.

*Fl. & Fr.*: Aug.- Jan.

Haman Khudi, *R.P. Pandey* 19856 (BSJO).

**Lycium edgeworthii** Dun.

Not common in dry clayey soil and on sandy sea-shores.

*Fl. & Fr.*: Sept.- Dec.

Mori R.F., *V. Singh* 15997 (BSJO).

**Physalis divaricata** D. Don

Common weed in open sandy-loam places.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi, *V. Singh* 15932 (BSJO); Mindhiari R.F., *V. Singh* 157800 (BSJO). Desalpar, *R.S. Raghavan* 114892 (BSI).

**Solanum anguivi** Lam.

Common in open gravelly - loamy habitat.

*Fl. & Fr.*: July - Jan.

Baranda, *R.P. Pandey* 19873 (BSJO).

**Solanum dubium** Fresen.

Common in open sandy habitat.

*Fl. & Fr.*: Oct.- Jan.

Along Guhar village, *R.P. Pandey* 17751 (BSJO).

**Solanum elaeagnifolium** Cav.

Rare in sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *V. Singh* 15811 (BSJO).

**Solanum incanum** L.

Not common in open sandy places.

*Fl. & Fr.*: Sept.- Dec.

Halapar R.F., *V. Singh* 15953 (BSJO).

**Solanum nigrum** L. "*Ubringini, Piludi*".

Not common in moist sandy soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar village, *R.P. Pandey* 17793 (BSJO); Mindhiari R.F., *V. Singh* 15874 (BSJO).

**\*Solanum virginianum** L. "*Bhoringini*".**Withania somnifera** (L.) Dun. "*Aswagandha*".

Common weed in open waste places in mixed habitat.

*Fl. & Fr.*: Oct.- Feb.

Along Guhar, *R.P. Pandey* 17741 (BSJO); Narayan Sarovar, *R.P. Pandey* 20017 (BSJO); Mindhiari R.F., *V. Singh* 15786 (BSJO).

## SCROPHULARIACEAE

**Bacopa monnieri** (L.) Pennell, "*Nevari*".

Frequently found in patches in moist sandy-loam soil.

*Fl. & Fr.*: Aug.- Jan.

Mindhiari R.F., *V. Singh* 15860 (BSJO).

**\*Camphylanthus ramosissimus** Wight**Kickxia ramosissima** (Wall.) Janchen

Common on dilapidated walls, river slopes or rock cuttings.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi river, *V. Singh* 15931, *R.P. Pandey* 13928 (BSJO).

**\*Schweinfurthia papilionacea** (L.) Merr.**Striga angustifolia** (D. Don) Saldanha

Common a root parasite of grasses.

*Fl. & Fr.*: After rainy season.

Haman Khudi, *V. Singh* 15940 (BSJO).



**Striga densiflora** (Benth.) Benth.

Not common in sandy-loam soil and on rock crevices.

*Fl. & Fr.*: Oct.- Dec.

Mindhiari R.F., *R.P. Pandey* 13975 (BSJO); Halapar, 13933 (BSJO).

**\*Striga gesneroides** (Willd.) Vayke

## PEDALIACEAE

**Pedaliium murex** L. "*Moto gokhru*".

Not common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar dam side, *R.P. Pandey* 17784(BSJO); Haman Khudi, *R.P. Pandey* 19851(BSJO); Mindhiari R.F., *V. Singh* 15793 (BSJO).

**Sesamum indicum** L. "*Til*".

Common weed in fallow and wastelands.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15704 (BSJO).

## ACANTHACEAE

**Barleria acanthoides** Vahl, "*Vajardanti*".

Occasionally found in sandy gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15794 (BSJO).

**Barleria prionitis** L. "*Kantaserito*".

Common along roadside and in forests in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15707 (BSJO).

**Blepharis linariaefolia** Pers.

Common in sandy gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi, *V. Singh* 15938 (BSJO).

**\*Blepharis maderaspatensis** (L.) Roth**Dipteracanthus patulus** (Jacq.) Nees

Common in rocky- gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Narayan Sarovar, Kunri, R.F., *V. Singh* 15901 (BSJO).

**Dipteracanthus patulus** (Jacq.) Nees var. **alba** (Saxton) Bhandari

Common forest undergrowth, in rocky habitat.

*Fl. & Fr.*: Aug.- Jan.

Mindhiari R.F., *R.P. Pandey* 13983(BSJO); Sandrovadh dam R.F., *R.P. Pandey* 20010 (BSJO).

**Justicia japonica** Thunb.

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15701 (BSJO).

**Lepidagathis trinervia** Wall. ex Nees

Common in sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi, *V. Singh* 15924 (BSJO).

**Peristrophe paniculata** (Forssk.) Brum. "*Kali - agedhi*".

Common in hedges and as forest undergrowth.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15770 (BSJO).

**\*Rostellularia diffusa** (Willd.) Nees**Rostellularia procumbens** (L.) Nees

Common in moist rocky- gravelly habitat.

*Fl. & Fr.*: Oct.- Dec.

Miadhriari Rakhal, *R.P. Pandey* 13981 (BSJO).

## AVICENNIACEAE

**Avicennia marina** (Forssk.) Vierh.

Abundant, forming a pure formation in saline marshy/ aquatic habitat.

*Fl. & Fr.*: Oct.- Jan.

Lakki mangrove forest, *R.P. Pandey* 17800 (BSJO).

## VERBENACEAE

**Clerodendrum multiflorum** (Burm.f.) Kuntze, "*Arni*".

Common in open sandy soil.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15854 (BSJO).

**\*Premna integrifolia** L.**Premna resinosa** Schau.

Not common in gravelly- rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Mori R.F., *V. Singh* 16001(BSJO); Guhar moti, *R.P. Pandey* 19863 (BSJO).

**Phyla nodiflora** (L.) Green, "*Ratvelio*".

Common in marshy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15870 (BSJO); Sheh, along Dayapar, *R.P. Pandey* 13951 (BSJO).

## LAMIACEAE

**Leucas cephalotes** (Koen. ex Roth) Spreng. “*Kubo*”.

Common in moist sandy-loam habitat.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *V. Singh* 15759 (BSJO).

**Leucas urticaefolia** (Vahl) R. Br.

Frequent, in moist sandy-loam shady places.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari Rakhal R.F., *V. Singh* 15747 (BSJO); Haman Khudi river, *R.P. Pandey* 13918 (BSJO).

**\*Ocimum americanum** L.**\*Ocimum basilicum** (L.) Druce, “*Ran tulsi, Takmaria, Jangli tulsi*”.**Salvia santolinifolia** Boiss.

Common in open sandy- gravelly places.

*Fl. & Fr.*: Sept. - Dec.

Haman Khudi, *V. Singh* 15923 (BSJO).

## NYCTAGINACEAE

**Boerhavia procumbens** Banks ex Roxb. “*Sathodi*”.

Not common in mixed habitat.

*Fl. & Fr.*: Oct.- Dec.

Guhar, *R.P. Pandey* 17763 (BSJO); Kunri R.F., *V. Singh* 15906 (BSJO).

**Boerhavia repens** L. “*Satho*”.

Common in sandy soil.

*Fl. & Fr.*: Oct.- Jan.

Guhar, *R.P. Pandey* 17774(BSJO); Nareda, *R.P. Pandey* 19876(BSJO); Haman Khudi, *R.P. Pandey* 19898 (BSJO).

**\*Commicarpus chinensis** (L.) Heimerl**Commicarpus helenae** (Schult.) Meikle, “*Moti - Sathodi*”.

Common in sandy- gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15737 (BSJO); Moti chher, *R.P. Pandey* 20024(BSJO); Haman Khudi, *R.P. Pandey* 19859 (BSJO).

## AMARANTHACEAE

**Achyranthes aspera** L. var. **aspera**, “*Agedho*”.

Common weed of the area, in mixed habitat.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F. *V. Singh* 15761(BSJO); Narayan Sarovar, *R.S. Raghavan* 114939 (BSI).

**\*Achyranthes aspera** L. var. **porphyristachya** Hook.f.

**Aerva javanica** (Burm. f.) Juss. ex Schult.

Common weed in open sandy-loam soil.

*Fl. & Fr.*: Sept.- Feb.

Guhar nani, *V. Singh* 15825 (BSJO).

**\*Aerva lanata** (L.) Juss. ex Schult.**Aerva javanica** (Burm. f.) Juss. ex Schult. var. **bovei** Webb.

Common in hummocky open places in sandy habitat.

*Fl. & Fr.*: Oct.- Feb.

Guhar village, *R.P. Pandey* 17758(BSJO); Kuriani, *R. P. Pandey* 20028 (BSJO).

**Alternanthera sessilis** (L.) R. Br. ex DC. "*Matsyaksi*".

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15877 (BSJO); Kanno, *V. Singh* 15975 (BSJO).

**Amaranthus hybridus** L. subsp. **cruentus** (L.) Thell var. **paniculata** (L.) Thell. "*Tanduliya*".

Not common in waste places in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15772 (BSJO).

**Amaranthus polygonoides** L.

Common weed in neglected areas, in mixed habitat.

*Fl. & Fr.*: After rainy season.

Deshalpar, *R.S. Raghavan* 114891 (BSI).

**\*Amaranthus spinosus** L.**Amaranthus tenuifolius** Willd.

Common weed, in open waste places.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15858 (BSJO).

**Amaranthus tricolor** L.

Common weed, in open moist places in sandy-loam habitat.

*Fl. & Fr.*: Oct.- Jan.

Haman Khudi, *R.P. Pandey* 13904 (BSJO); Tera village, *R.P. Pandey* 17776 (BSJO); Moti chher, *R.P. Pandey* 20023 (BSJO); Narayan Sarovar, *V. Singh* 15805 (BSJO).

**Amaranthus viridis** L.

Common weed, in open sandy moist waste places.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *V. Singh* 15798 (BSJO).

**Celosia argentea** L. "*Lampadi*".

Common weed in fallow fields and open waste places.

***Digera muricata* (L.) Mart.**

Common weed in open sandy- gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Along Guhar, *R.P. Pandey* 17734 (BSJO); Haman Khudi, *R.P. Pandey* 19849 (BSJO); Mindhiari R.F., *V. Singh* 15727 (BSJO).

***Nothosaerva brachiata* (L.) Wight**

Common in drying moist grounds.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15867 (BSJO); Halapar R.F., *V. Singh* 15946 (BSJO).

***Pupalia lappacea* (L.) Juss.**

Common weed in mixed habitat.

*Fl. & Fr.*: Sept.- Feb.

Mindhiari R.F., *V. Singh* 15734 (BSJO); Mori R.F., *V. Singh* 15989 (BSJO); Along Guhar, *R. P. Pandey* 17752 (BSJO).

## CHENOPODIACEAE

***Atriplex stocksii* (Wight) Boiss.**

Common in saline habitat.

*Fl. & Fr.*: Sept.-Feb.

Narayan Sarovar, *R.S. Raghavan* 114928 (BSI).

***Chenopodium album* L. “Chili”.**

Common weed in cultivated fields.

*Fl. & Fr.*: Sept.- Dec.

Guhar, *R.P. Pandey* 17756 (BSJO).

***Chenopodium murale* L.**

Common weed in fallow fields.

*Fl. & Fr.*: Sept.- Mar.

Devisar, *R.S. Raghavan* 114871 (BSI).

***Salicornia brachiata* Roth, “Lantho”.**

Not common in tidal zone saline habitat.

*Fl. & Fr.*: Sept.- Apr.

Narayan Sarovar, *R.S. Raghavan* 114942 (BSI).

***Suaeda fruticosa* (L.) Forssk. ex Fanel, “Moral”.**

Common along coastal area in saline habitat.

*Fl. & Fr.*: Sept.- Apr.

Lakhi Mangrove forest, *R.P. Pandey* 17797 (BSJO); Koteswar along sea, *R.P. Pandey* 12108, 13949 (BSJO); Narayan Sarovar, *R.S. Raghavan* 114938, 114941, *S.K. Jain* 61924, 61925 (BSI).

***Suaeda maritima* (L.) Dumort, “Moral, Unth - moral”.**

Rare in saline habitat.

*Fl. & Fr.*: Sept.- Mar.

Kannoj, *V. Singh* 15984.

\****Suaeda nudiflora*** (Willd.) Moq., “*Lana*”.

#### POLYGONACEAE

***Polygonum plebeium*** R. Br.

Rare in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15859 (BSJO).

#### ARISTOLOCHIACEAE

***Aristolochia bracteolata*** Lam. “*Kidamari*”.

Common along dam- side, ponds etc in sandy- clayey soil.

*Fl. & Fr.*: Sept.- Mar.

Desalpar, *R.S. Raghavan* 114885 (BSI).

#### EUPHORBIACEAE

\****Breynia retusa*** (Dennst.) Alston, “*Kamboi, Kali kamboi*”.

***Dalechampia scandens*** L. var. ***cordofana*** (Hochst. ex Webb.) Muell.- Arg. “*Virshchekali*”.

Herbaceous climber on hedges and trees.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi, *R.P. Pandey* 13915(BSJO); Sandrovadh R.F., *R.P. Pandey* 20005 (BSJO); Mindhiari R.F., *V. Singh* 15710 (BSJO).

***Euphorbia caducifolia*** Haines, “*Thor*”.

Common in rocky gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 15965 (BSJO); Bhonar hills, *R.P. Pandey* 12102 (BSJO).

***Euphorbia clarkeana*** Hook. f. “*Dudheli*”.

Common in open moist rocky habitat.

*Fl. & Fr.*: After rainy season.

Mindhiari R.F., *R.P. Pandey* 13959, *V. Singh* 15779 (BSJO); Guhar tank, *R.P. Pandey* 17735(BSJO); Sandrovadh R.F., *R.P. Pandey* 20011(BSJO); Kunri R.F., *V. Singh* 15905 (BSJO); *R.S. Raghavan* 114930 (BSI).

\****Euphorbia geniculata*** Orteg.

***Euphorbia heterophylla*** L.

Common weed in open sandy moist places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15773 (BSJO).

***Euphorbia heyneana*** Spreng.

Common in moist sandy habitat.

*Fl. & Fr.*: Sept.- Jan.

Guhar, *R.P. Pandey* 17767 (BSJO); Narayan Sarovar, *V. Singh* 15804, *R.P. Pandey* 20015 (BSJO).

**Euphorbia hirta** L. "*Dudheli*".

Common in moist gravelly-loamy soil.

*Fl. & Fr.*: Sept. - Jan.

Haman Khudi, *R.P. Pandey* 13904 (BSJO); Mindhiari R.F., *V. Singh* 15764 (BSJO).

**Euphorbia indica** Lam.

Common weed in moist sandy-loam soil.

*Fl. & Fr.*: After rainy season.

Haman Khudi, *V. Singh* 15919 (BSJO).

**\*Euphorbia nivulia** L. "*Vad thor*".**\*Euphorbia tirucalli** L. "*Kharsani*" (Planted).**Phyllanthus fraternus** Webster, "*Bhionamlli*".

Not common in moist loamy habitat.

*Fl. & Fr.*: After rainy season.

Haman Khudi, *R.P. Pandey* 13909 (BSJO); Mindhiari R.F., *R.P. Pandey* 13956 (BSJO); Guhar, *R. P. Pandey* 19845 (BSJO).

**Phyllanthus maderaspatana** L.

Common in moist loamy- sandy soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15762, 15893 (BSJO).

**Ricinus communis** L.

Commonly cultivated in sandy-loam soil as a crop.

*Fl. & Fr.*: Aug.- Mar.

Narayan Sarovar, *R.P. Pandey* 20021 (BSJO).

**\*Securinega virosa** (Roxb. ex Willd.) Baillon, "*Safed fail, Pichrun*".

## MORACEAE

**Ficus benghalensis** L.

Commonly planted near habitations, along roads and temples, in mixed habitat.

*Fl. & Fr.*: Aug.- Mar.

Narayan Sarovar, *R.P. Pandey* 20032 (BSJO).

**Ficus microcarpa** L. f.

Commonly planted near habitations, in sandy-loam soil.

*Fl. & Fr.*: Aug.- Feb.

Narayan Sarovar, *R. P. Pandey* 20033 (BSJO).

## CASURINACEAE

**\*Casurina equisetifolia** L. "*Sharu*".

## HYDROCHARITACEAE

**\*Hydrilla verticillata** (L.f.) Royle

**Vallisneria spiralis** L. var. **denseserrulata** Makino

Not common in aquatic habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari, R.F., *V. Singh* 15846 (BSJO).

## LILIACEAE

**\*Aloe vera** (L.) Burm.f. "*Kunvarpato*".**Asparagus africanus** Lam.

Common in rocky- gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Guhar dam, *R. P. Pandey* 17786 (BSJO).

**Asparagus dumosus** Baker

Common in rocky- gravelly places.

*Fl. & Fr.*: Sept.- Jan.

Kunri R.F., *V. Singh* 15914 (BSJO); Narayan Sarovar tank side, *R. P. Pandey* 19841 (BSJO); Narayan Sarovar, *S. K. Jain* 61954 (BSI).

**Asparagus racemosus** Willd.

Common in rocky- gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15714 (BSJO).

**Dipcadi erythraeum** Webb. & Berth.

Common along river-beds and on low hillocks in sandy to gravelly places.

*Fl. & Fr.*: July- Nov.

Haman Khudi, *R.P. Pandey* 19850 (BSJO).

## COMMELINACEAE

**Commelina benghalensis** L.

Common in moist sandy-loam soil.

*Fl. & Fr.*: Aug.- Nov.

Kuriani, along Lakhsapat, *R.P. Pandey* 20025 (BSJO).

**Commelina forsskalaei** Vahl

Common in moist sandy-loam shady places.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15771, *R.P. Pandey* 13964 (BSJO).

**\*Commelina hasskarlii** C.B.Clarke**Commelina suffruticosa** Blume

Frequent, in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhriari Rakhal R.F., *V. Singh* 15741 (BSJO); Narayan Sarovar, *V. Singh* 15904 (BSJO).



## ARECACEAE

\***Phoenix dactylifera** L. “*Khajuri*”.

\***Phoenix sylvestris** (L.) Roxb. “*Khajuri*”.

## TYPHACEAE

**Typha domingensis** Pers.

Not common in marshy or aquatic habitat.

*Fl. & Fr.*: Aug.- Dec.

Mindhiari R.F., *V. Singh* 15719 (BSJO).

\***Typha elephantina** Roxb.

## POTAMOGETONACEAE

**Potamogeton nodosus** Poir.

Common in aquatic habitat.

*Fl. & Fr.*: Aug.- Dec.

Guhar dam, *V. Singh* 15836 (BSJO).

## NAJADACEAE

**Najas minor** All.

Common in aquatic habitat.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15849 (BSJO).

## CYPERACEAE

**Bolboschoenus maritimus** (L.) Palla

Not common in moist loamy- clayey soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15716 (BSJO); Guhar dam, *R.P. Pandey* 17780 (BSJO); Nareda, *R.P. Pandey* 19880 (BSJO), *V. Singh* 15831 (BSJO).

**Cyperus atkinsonii** C.B. Clarke

Common in gravelly- sandy soil.

*Fl. & Fr.*: Sept.- Jan.

Nareda- along Nalia, *R.P. Pandey* 13946 (BSJO); Guhar nani, *V. Singh* 15818 (BSJO).

**Cyperus compressus** L.

Occasional, in moist sandy places.

*Fl. & Fr.*: Sept.- Jan.

Guhar village, *R.P. Pandey* 17764 (BSJO).

**Cyperus difformis** L.

Frequent, in moist sandy places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15848 (BSJO).

**Cyperus flabelliformis** Rottb.

Common in moist sandy-loam habitat.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15882 (BSJO).

**Cyperus iria** L.

Not common in moist sandy places.

*Fl. & Fr.*: Sept.- Dec.

Halapar R.F., *V. Singh* 15947 (BSJO).

**Cyperus pygmaeus** Rottb.

Common in marshy habitat.

*Fl. & Fr.*: Sept.- Dec.

Guhar dam, *R.P. Pandey* 17788, *V. Singh* 158233 (BSJO).

**Cyperus rotundus** L. "*Motha, Mostha*".

Common in moist rocky- loamy habitat.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi, *R.P. Pandey* 13907 (BSJO).

**Cyperus rotundus** L. var. **centiflora** C.B.Clarke

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *V. Singh* 15819 (BSJO).

**Eleocharis geniculata** (L.) Roem. & Schult.

Common in moist sandy soil.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15713 (BSJO).

**Fimbristylis bisumbellata** (Forssk.) Bubani

Common in marshy places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15869 (BSJO).

**Fimbristylis ferruginea** (L.) Vahl

Common in marshy places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15872 (BSJO).

**Fimbristylis quinquangularis** (Vahl) Kunth

Very common in moist loamy soil.

*Fl. & Fr.*: Aug.- Dec.

Halapar, *R.P. Pandey* 13934 (BSJO).

**Mariscus squarrosus** (L.) C.B. Clarke

Very common along stream in marshy loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Halapar, *R.P. Pandey* 13938 (BSJO).

**Pycreus flavidus** (Retz.) Koyama

Common in moist sandy places.

*Fl. & Fr.*: Sept.- Dec.

Sheh, *V. Singh* 15968 (BSJO).

**Pycreus flavidus** (Retz.) Koyama var. **strictus** (Lam.) Parmar

Rare in moist sandy places.

*Fl. & Fr.*: Sept.- Dec.

Guhar nani, *V. Singh* 15835 (BSJO).

**\*Pycreus pumilus** (L.) Nees ex C.B. Clarke**Schoenoplectus roylei** (Nees) Lye

Common in moist sandy habitat.

*Fl. & Fr.*: Sept.- Dec.

Guhar dam, *R.P. Pandey* 17783, *V. Singh* 15812 (BSJO); Mindhiari R.F., *V. Singh* 15886 (BSJO).

## POACEAE

**Acrachne racemosa** (Heyne ex Roem. & Schult.) Ohwi

Common in sandy-loam habitat.

*Fl. & Fr.*: July- Nov.

Haman Khudi, *R. P. Pandey* 19895 (BSJO).

**Aeluropus lagopoides** (L.) Trin. ex Thw.

Fairly common in saline habitat.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 15957 (BSJO); Narayan Sarovar, *R.S. Rao* 114914 (BSI).

**\*Andropogon pumilus** L. “Zinzuo”.**Apluda mutica** L.

Common in sandy gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Mori, R.F., *V. Singh* 15999 (BSJO); Mindhiari R.F., *V. Singh* 15756 (BSJO).

**Aristida adscensionis** L.

Very common in open gravelly plains.

*Fl. & Fr.*: Sept.- Dec.

Watchtower, Halapar, *R. P. Pandey* 13945 (BSJO); Rodasar, *V. Singh* 15959 (BSJO).

**Aristida funiculata** Trin. & Rupr.

Common in dry open sandy soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15888 (BSJO).

**Brachiaria ramosa** (L.) Stapf

Common in gravelly- rocky places.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *V. Singh* 15782, 15788 (BSJO).

**Cenchrus biflorus** Roxb.

Common in open sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *V. Singh* 15828 (BSJO).

**Chloris barbata** Sw.

Common in open places and in mixed habitat.

*Fl. & Fr.*: Sept.- Dec.

Narayan Sarovar, *R.P. Pandey* 17742 (BSJO).

**Cristida ciliaris** L.

Common in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar nani, *V. Singh* 15834 (BSJO).

**Cristida prieurii** (Kunth) Maire

Fairly common along stream in rocky- loamy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13953(BSJO); Baranda, *R.P. Pandey* 19870 (BSJO).

**Cristida setigerus** Vahl

Common in hummocky plains in moist loamy soil.

*Fl. & Fr.*: Sept.- Jan.

Haman Khudi River, *R.P. Pandey* 13925 (BSJO); Sheh, *V. Singh* 15972 (BSJO).

**Cristida virgata** Sw.

Common in moist sandy-loam soil in open places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15766 (BSJO).

**Chrysopogon aucheri** (Boiss.) Stapf

Common in open dry rocky gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi, *V. Singh* 15934 (BSJO).

**Cristida fulvus** (Spreng.) Chiov.

Common in open places, in moist loamy soil.

*Fl. & Fr.*: Sept.- Jan.

Halapar, R.F., *R.P. Pandey* 13937 (BSJO).

**Cristida serrulatus** Trin.

Common in gravelly- loamy soil.

*Fl. & Fr.*: July- Nov.

Jadava, along Baranda road, Devisar, *R.P. Pandey* 19868, 19813 (BSJO).

**Cymbopogon commutatus** (Steud.) Stapf

Not common in sandy habitat.

*Fl. & Fr.*: Sept.- Jan.

Rodasar, *V. Singh* 15960 (BSJO).

**Cristida martinii** (Roxb.) W. Watson

Common in sandy- gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Along Guhar village, *R.P. Pandey* 17747 (BSJO).

**Cristida parkerii** Stapf

Not common in sandy gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Narayan Sarovar, *R.S. Raghavan* 114936 (BSI).

**\*Cynodon dactylon** (L.) Pers. “*Darbh*”.**Dactyloctenium aegyptium** (L.) Willd.

Common in open sandy-loam soil.

*Fl. & Fr.*: Oct.- Jan.

Guhar, *R.P. Pandey* 17777(BSJO); Haman Khudi, *R.P. Pandey* 19893 (BSJO); Mindhiari R.F., *V. Singh* 15792 (BSJO).

**Dactyloctenium aristatum** Link

Common in sandy places.

*Fl. & Fr.*: July- Nov.

Haman Khudi, *R. P. Pandey* 19860 (BSJO).

**Dactyloctenium scindicum** Boiss.

Fairly Common in sandy soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar, *R. P. Pandey* 17769, *V. Singh* 15817(BSJO); Nareda, *R. P. Pandey* 19883 (BSJO).

**Desmostachya bipinnata** (L.) Stapf, “*Dab*”.

Common in sandy to gravelly habitat.

*Fl. & Fr.*: Sept.- Jan.

Kunri R.F., *V. Singh* 15911 (BSJO).

**Dichanthium annulatum** (Forssk.) Stapf

Common in moist sandy-loam to gravelly- loam soil.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi, *V. Singh* 15929 (BSJO); Mori R.F., *V. Singh* 15994 (BSJO); Nalia village, *R.P. Pandey* 17727 (BSJO).

**Dichanthium foveolatum** (Del.) Roberty

Common in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Mori R.F., *V. Singh* 15998 (BSJO).

\***Dichanthium pertusum** (L.) Clayton, “Zenzvo, Jinjvo”.

**Digitaria ciliaris** (Retz.) Koel.

Not common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Kunri R.F., *V. Singh* 15909 (BSJO).

**Dinebra retroflexa** (Vahl) Panz.

Frequent, in dry loamy- clayey soil.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 159534 (BSJO).

**Echinochloa colona** (L.) Link

Common along streams in moist rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13963 (BSJO); Jadava, *R.P. Pandey* 19887 (BSJO); Halapar R.F., *V. Singh* 15949 (BSJO); Mori R.F., *V. Singh* 16000 (BSJO).

**Echinochloa crusgallii** (L.) P. Beauv.

Common in moist sandy- clayey soil.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15847 (BSJO).

**Eragrostis cilianensis** (All.) Vignolo- Lutai

Common in sandy- clayey soil.

*Fl. & Fr.*: Sept.- Dec.

Halapar R.F., *V. Singh* 15948 (BSJO); Nalia, *W.J. Stower* C-64 (BSI).

**Eragrostis ciliaris** (L.) R. Br.

Common in moist sandy soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar, *R.P. Pandey* 17768 (BSJO); Mindhiari R.F., *V. Singh* 15790 (BSJO).

**Eragrostis ciliaris** (L.) R. Br. var. **brachystachya** Boiss.

Not common in moist sandy soil.

*Fl. & Fr.*: Sept.- Dec.

Haman Khudi, *V. Singh* 15967 (BSJO).

**Eragrostis gangetica** (Roxb.) Steud.

Common in sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 15961 (BSJO).

**Eragrostis japonica** (Thunb.) Trin.

Common in open sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 15964 (BSJO); Mindhiari R.F., *V. Singh* 15895 (BSJO).

**Eragrostis minor** Hochst.

Common in sandy places.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 159631 (BSJO); Mindhiari R.F., *V. Singh* 15894 (BSJO).

**Eragrostis tremula** (L.) Hochst. ex Steud.

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Mindhiari R.F., *R.P. Pandey* 13960, *V. Singh* 15789 (BSJO).

**\*Eragrostis uniolooides** (Retz.) Nees ex Steud.

**Heteropogon contortus** (L.) P. Beauv. ex Roem. & Schult.

Common in gravelly rocky places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15890 (BSJO).

**\*Ischaemum indicum** (Houtt.) Merr.

**\*Isilema laxum** Hack.

**Melanocenchris jacquemontii** Jaub. & Spach.

Common in open gravelly habitat.

*Fl. & Fr.*: Sept.- Dec.

Near Halapar watch tower, *R.P. Pandey* 13943(BSJO); Nareda, *R.P. Pandey* 19885 (BSJO); Haman Khudi, *V. Singh* 15922 (BSJO).

**Ochthochloa compressa** (Forssk.) Hilu

Not common in gravelly-loamy soil.

*Fl. & Fr.*: Oct.- Dec.

Guhar dam, *R.P. Pandey* 17791, 17799 (BSJO).

**Panicum antidotale** Retz.

Common in gravelly- sandy habitat in clumps.

*Fl. & Fr.*: Sept.- Jan.

Along Guhar tank, *R.P. Pandey* 17737 (BSJO).

**Panicum trypheron** Schult.

Common in moist sandy places.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15782-A (BSJO).

\***Paspalum scrobiculatum** L. “Kodri, Maniakodru”.

\***Pennisetum glaucum** (L.) R. Br. “Bajri, Bajro” (Cultivated).

**Phragmites karka** (Retz.) Trin. ex Steud.

Not common in moist sandy soil.

*Fl. & Fr.*: Sept.- Dec.

Kannoj, *V. Singh* 15978 (BSJO).

\***Saccharum bengalensis** Retz.

\***Sehima sulcatum** (Hack.) A. Camus

\***Setaria glauca** (L.) P. Beauv.

\***Sorghum bicolor**(L.) Mrench. “Jowar” (Cultivated).

\***Setaria fertilis** (Steud.) Clayton

\***Setaria helvolus** (Trin.) Thw.

**Setaria ioclados** (Nees ex Trin.) Nees

Common in saline habitat and in moist clayey soil.

*Fl. & Fr.*: Sept.- Dec.

Lakki mangrove forest, *R.P. Pandey* 17798 (BSJO); Nareda along Nalia road, *R.P. Pandey* 13947 (BSJO); Mindhiari R.F., *V. Singh* 15844 (BSJO).

**Setaria maderaspatenus** Bor

Common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Dec.

Rodasar, *V. Singh* 15958 (BSJO).

**Setaria tenuissimus** (Sch.) Kuntze

Common in moist sandy-loam habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15896 (BSJO).

**Setaria verticillata** (L.) P. Beauv.

Common in moist sandy habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *V. Singh* 15787 (BSJO).

**Sporobolus indicus** (L.) R.Br. var. **flaccidus** (Roem. & Schult.) Veldk.

Common in moist sandy habitat.

*Fl. & Fr.*: Sept.- Nov.

Guhar dam, *R.P. Pandey* 17789 (BSJO).

**Tetrapogon tenellus** (Roxb.) Chiov.

Common near streams in moist rocky habitat.

*Fl. & Fr.*: Sept.- Dec.

Mindhiari R.F., *R.P. Pandey* 13961, *V. Singh* 15889 (BSJO); Guhar dam, *R.P. Pandey* 19891 (BSJO).

**Themeda cymbaria** Hack.

Not common in moist sandy-loam soil.

*Fl. & Fr.*: Sept.- Jan.

Guhar nani, *V. Singh* 15816 (BSJO).



**\**Themeda tremula*** (Nees ex Steud.) Hack.

***Tragus roxburghii*** Panigrahi

Not common in sandy- gravelly soil.

*Fl. & Fr.*: Sept.- Dec.

Guhar tank, *R.P. Pandey* 17771 (BSJO).

**\**Triticum aestivum*** L. “*Gauv*” (Cultivated).

***Urochondra setulosa*** (Trin.) Hubb.

Rare in sandy- gravelly or saline habitats.

*Fl. & Fr.*: Sept.- Dec.

Halapar R.F., *V. Singh* 15951 (BSJO).

#### GYMNOSPERM : GNETACEAE

**\**Ephedra foliata*** Boiss. “*Andho khip*”.

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## नारायण सरोवर वन्यजीव अभयारण्य, कच्छ, गुजरात, भारत की वनस्पति विविधता

आर.पी. पाण्डेय, वी. सिंह एवं पी.जे. परमार

### सार संक्षेप

प्रस्तुत शोधपत्र में वनस्पति, पुष्पी संरचना एवं विश्लेषण, वन के प्रकार तथा उनके साहचर्य के विवरण हैं। इनमें 247 वंशों एवं 74 कुलों के अंतर्गत संवहनी पौधों की 455 जातियाँ हैं। इसके अलावा जैव परिप्रेक्ष्य वाले महत्वपूर्ण आर्थिक पौधे, कृषि पौधे और उनके 14 वन्य कुटुम्ब, 39 ऐसे दुर्लभ, संकटापन्न एवं स्थानिक टैक्सा जिनके जर्मप्लाज्म के हेतु प्रभावी संरक्षण के उपाय, प्रबंधन दबाव तथा संस्तुतियाँ दी गई हैं।

## LIVERWORT DIVERSITY IN PALNI HILLS (TAMIL NADU), INDIA, – A CHECKLIST

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### ABSTRACT

Current investigations show the occurrence of 75 taxa of liverworts in Kodaikanal and neighbouring areas. Each species has been enumerated along with the details of exsiccatae, ecology, range of distribution and status in the study area.

**Keywords :** Bryophyta, Distribution, Diversity, Kodai kanal, Liverwort, Palni hills.

### INTRODUCTION

Palni hills, located in the Eastern offshoots of Western Ghats, have received inadequate attention for bryological studies though it provide conducive environment for the luxuriant preponderance of these little, non-vascular land plants. The past bryofloristic studies in the area are fragmentary and far from satisfactory (see Foreau, 1931, 1961, 1964; Udar, 1976, Dabhade, 1998, Srivastava, 1998). Many taxa described earlier are stated to be not traceable even in their original locations and our knowledge about the present status of each species is not clearly known, hence an attempt has been made to provide an up to date information about the current status of hepatic diversity of Palni hills.

The first ever record of Hepaticae (liverworts) from Palni hills comes from Stephani (1898 - 1924) who described 7 species. Chopra (1938a) listed 40 species of liverworts from various localities of Palni hills chiefly based on collections made by Rangachariar, Father Foreau, Mrs. Robinson and Rupinat between 1916 - 1934. Pande and Bhardwaj (1952) recognized 20 genuine species of liverworts from this region. Earlier contributions made by Indian workers provide morpho-taxonomic information of about 30 species. Current investigations have however, revealed 75 species which include significant additions in the floristic elements of the liverworts of the area (see Foreau, 1931, 1961, 1964; Udar, 1959; Kachroo, 1958; Udar & Srivastava, 1964, 1970, 1983; Srivastava & Udar, 1976, 1979; Udar & Kumar, A., 1981; Sharma & Srivastava, 1993; Bapna & Kachroo, 2000; Parihar & al., 1994; Srivastava, A & Srivastava, 2002; Srivastava, 1994, 1998). During the present investigations 10 species are added to the region as new records. Out of the 75 species 16 species (\*) could not be located during the course of present investigations and are included on the basis of previous reports.

Investigations during last few years on several exhaustive collections and surveys made by the authors and their associates provide the first authentic record of the liverwort diversity occurring in this region. The areas explored include Kodaikanal, Shembaganur, Silver Cascade, Tiger Shola, Palangi, Attuvampatti and Periakulum, having variable topography and microclimate, with much diversified taxa in the region. The study eventually revealed the occurrence of 36 genera and 75 species falling under 3 orders and 21 families. The Metzgeriales is represented with 4 families, 5 genera and 15 species. The Jungermanniales with 11 families, 21 genera and 47 species have maximum representation, whereas Marchantiales have 6 families, 10 genera and 13 species in the study area.

### TOPOGRAPHY

Palni hills, lying between 10°12' - 10°15' N latitude and 77°26' - 77°33' E longitude, comes under Dindigul district of Tamil Nadu, India, and is a part of Eastern Ghats. The area shows an altitudinal range of 360 - 2550 m. It extends in a North-east - South-west streak in Indian peninsula covering an area of about 75,000 sq km with an average width of 200 km in the North and 100 km in South. It extends over a length of 1750 km between Mahanadi and Vaigai rivers along the East coast. Mahanadi basin marks the northern boundary of the Eastern Ghats while the southern edge is the Nilgiri hills. The weather varies over the range, but much of the plateau receives an average of more than 1500 mm of rainfall annually, with not more than four dry months. In the higher areas mean day temperature in the coolest months is below 17°C.

ENUMERATION  
ORDER : METZGERIALES  
FOSSOMBRONIACEAE

**1. Fossombronia cristula** Austin.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 3 F/1966 (LWU).

*Ecology* : Terrestrial, grows in moist conditions, usually on wet and damp soil or soil covered rocks along with grasses, moss and other liverworts like *Cephaloziella* sp., etc.

*Distribution* : Asia : India, Japan, Taiwan; North America : United State of America (New Jersey, California, Texas) (see Udar & Srivastava, 1969; Srivastava & Udar, 1975b; Schuster, 1992a).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**2.\*Fossombronia foreau**i Udar & S. C. Srivast.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal; CSIR No. 38F/1966 (LWU).

*Ecology* : Plants grow on moist soils on rocks in pure growth or sometimes associated with other species of *Fossombronia*.

*Distribution* : Endemic to India (Srivastava & Udar, 1975b).

*Status in Palni hills* : Rare in Kodaikanal (Palni hills).

**3. Fossombronia himalayensis** Kashyap (**Plate:1; Fig.:1**).

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 13052/2000 (LWU).

*Ecology* : Terrestrial, grows usually in moist and shady places, rarely on exposed rocks and soil covered rocks associated with other taxa.

*Distribution* : Endemic to India (Srivastava & Udar, 1975b).

*Status in Palni hills* : Rare in Kodaikanal (Palni hills).

**4. Fossombronia wondraczekii** (Corda) Dumort.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal; 12961/2000, 12973/2000 (LWU).

*Ecology* : Terrestrial, grows normally in dense patches on moist and exposed rocks and soil covered rocks along with other terrestrial mosses.

*Distribution* : India, Europe (Srivastava & Udar, 1975b).

*Status in Palni hills* : Rare in Kodaikanal (Palni hills).

PALLAVICINIACEAE

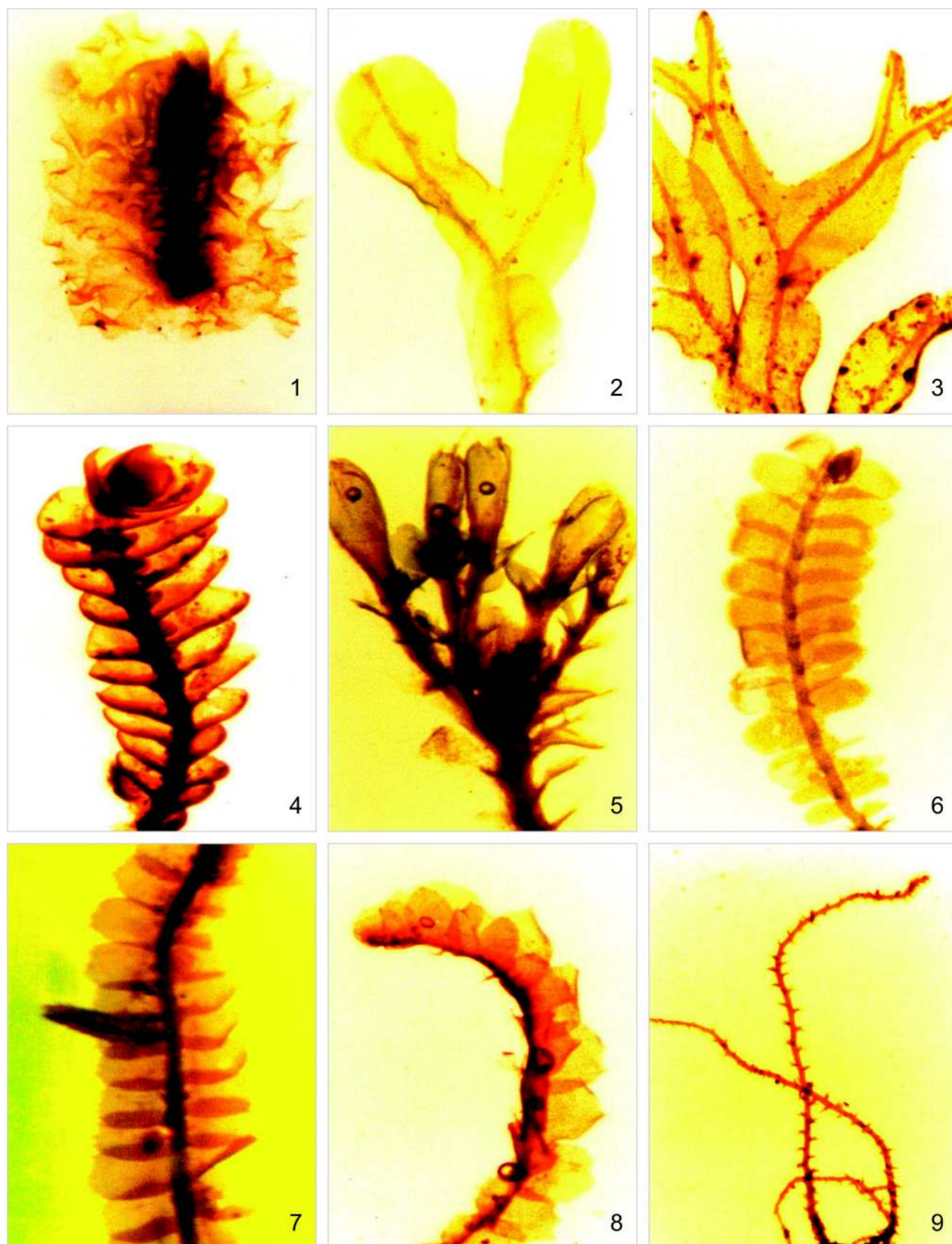
**5.\*Pallavicinia crispatus** (Mont.) Steph.

*Specimens examined* : Included on the basis of listing by Bapna and Kachroo (2000).

*Ecology* : Terrestrial, grows on moist and shady rocks and soil covered wet rocks.

*Distribution* : Endemic to India (see Bapna & Kachroo, 2000).

*Status in Palni hills* : Not traceable hence doubtful.



**Plate 1.** 1. *Fossombronina himalayensis* ( $\times 14$ ); 2. *Metzgeria indica* ( $\times 12$ ), 3. *Metzgeria nilgiriensis* ( $\times 13$ ); 4. *Gottschelia schizopleura* ( $\times 11$ ); 5. *Jungermannia (Jung.) lanceolata* ( $\times 8$ ); 6. *Notoscyphus darjeelingensis* ( $\times 9$ ); 7. *Heteroscyphus argutus* ( $\times 9$ ); 8. *Heteroscyphus argutus* ( $\times 9$ ) and 9. *Heteroscyphus orbiculatus* ( $\times 8$ ).

## METZGERIACEAE

**6. \*Metzgeria consanguinea** Schiffn.

*Specimen examined* : South India : Tamil Nadu - Palni hills - Kodaikanal : Bryant Park; 53 M/1966 (LWU).

*Ecology* : Corticolous, grows in moist and shady conditions.

*Distribution* : India, Indonesia, Sri Lanka, Sumatra, New Guinea, Africa, Congo, Kenya, Korea, Japan. (see Srivastava & Udar, 1975a; Bapna & Kachroo, 2000).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**7. Metzgeria himalayensis** Udar & S. C. Srivast.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Bryant Park; 59 M/1966 (LWU).

*Ecology* : Corticolous, grows in moist and shady conditions.

*Distribution* : Endemic to India (Srivastava & Udar, 1975a).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**8. Metzgeria indica** Udar & S. C. Srivast. (**Plate : 1; Fig. : 2**).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal - Perumalmalai : 13065/2000, 13203/2000, 13206/2000 (LWU); Kodai Lake : 20084/2006, 20088/2006, 20090/2006, 20094/2006, 20100/2006, 20114/2006, 20127/2006, 20128/2006 (LWU).

*Ecology* : Corticolous, grows in moist and shady conditions.

*Distribution* : Endemic to India (Srivastava & Udar, 1975a).

*Status in Palni hills* : Common; out of risk.

**9. \*Metzgeria nilgiriensis** Udar & S. C. Srivast. (**Plate : 1; Fig. : 3**).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Bryant Park; 53 M/1966, 13203/2000, 13206/2000 (LWU).

*Ecology* : Corticolous, grows in moist and shady conditions.

*Distribution* : Endemic to India (Srivastava & Udar, 1975a).

*Status in Palni hills* : Common.

## ANEURACEAE

**10. Aneura maxima** (Schiffn.) Steph.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 48 A/1966, 13048/2000, 13049/2000; 20093/2006, 20096/2006 (LWU).

*Ecology* : On soil covered moist rocks in shady places.

*Distribution* : Asia- India, Japan (see Srivastava & Udar, 1976; Bapna & Kachroo, 2000).

*Status in Palni hills* : Common.

**11. Aneura pinguis** (L.) Dumort.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 47 A/1966, 50 A/1966, 57 A/1966, 12965/2000, 12971/2000; 20120/2006, 20121/2006, 20123/2006 (LWU).

*Ecology* : On soil covered moist rocks.

*Distribution* : Asia- China, Japan, India, Indonesia (Java), Manchuria, Sri Lanka; Siberia; Australia,

New Zealand; North America- West Indies; South America- Brazil; Europe and Africa (see Srivastava & Udar, 1976; Bapna & Kachroo, 2000).

*Status in Palni hills* : Common; out of risk.

**12. Riccardia levieri** Schiffn.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 89 R/1966, 12971/2000, 20080/2006, 200124/2006(LWU).

*Ecology* : It grows on moist and shady soil surfaces near water in association with *Aneura* sp.

*Distribution* : Asia- Bhutan, India (Srivastava & Udar, 1976).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**13. Riccardia multifida** (L.) Gray

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal, Perumalmalai; 38 R/1966, 12124/2000, 200125/2000 (LWU).

*Ecology* : It grows on moist and shady soil surface or soil covered rocks.

*Distribution* : Asia- China, India, Sri Lanka; North America; Europe; Alaska; Africa (Srivastava & Udar, 1976; Bapna & Kachroo, 2000).

*Status in Palni hills* : Vulnerable in Kodaikanal.

**14. Riccardia perssonii** S. C. Srivast. & Udar

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 100 R/1966 (LWU).

*Ecology* : It grows on moist and shady soil surfaces and soil covered rocks usually in pure population.

*Distribution* : Endemic to India (Srivastava & Udar, 1976).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**15. Riccardia tenuicostata** Schiffn.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 76 R/1966, 84 R/1966 (LWU).

*Ecology* : It grows on moist and shady soil surfaces and soil covered rocks and as an epiphyte on bark at the base of trees.

*Distribution* : Asia- India, Indonesia, Singapore (Srivastava & Udar, 1976).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

ORDER : JUNGERMANNIALES

LOPHOZIACEAE

**16. Gottschelia schizopleura** (Spruce) Grolle (**Plate :1; Fig. : 4**).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 55 S/1972, 13027/200, 13033/2006 (LWU).

*Ecology* : Terricolous, grows on moist and shady soil surface.

*Distribution* : Africa- E. Africa, Madagascar; Asia- China, Celebes, India, Indonesia, Malaysia, Philippines, Sri Lanka, Norfolk Island, Papua New Guinea, Iran (see Udar & Kumar. A, 1982; Bapna & Kachroo, 2000).

*Status in Palni hills* : Common in Palni hills.

## JUNGERMANNIACEAE

**17. *Jungermannia lanceolata* L. emend Schrad. (Plate : 1; Fig. : 5).**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 7429/1983 (LWU).

*Ecology* : Terrestrial, grows on soil covered rocks in damp conditions.

*Distribution* : Europe- Norway, Sweden, Finland, Denmark, Britain, Germany, France, Austria, Spain, Switzerland, CIS; Asia - India, Japan; North America (see Udar & Kumar, A. 1982; Schuster, 1969).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**18. *Jungermannia truncata* Nees**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 20086/2006, 13081/2000 (LWU).

*Ecology* : Terrestrial, grows in shady places over the soil/ rock surface on road sides either in pure patches or in association with *Riccardia* sp.

*Distribution* : Asia - India, Myanmar, China, Taiwan, Indonesia, Korea, Kwashyota Island, Malaysia, New Guinea, Philippines, Thailand (Kumar, A. 1982).

*Status in Palni hills* : Vulnerable. New record for Palni hill.

**19. *Jungermannia pyriformis* Steph. (Plate : 1; Fig. : 6).**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 12429/1966 (LWU).

*Ecology* : Terrestrial, grows in shady and moist condition on soil covered rocks.

*Distribution* : Asia – India, Japan (see Singh, P., 1991).

*Status in Palni hills* : Endangered. New to Kodaikanal (Palni hills).

**20. *Notoscyphus darjeelingensis* Udar & A. Kumar (Plate : 1; Fig. : 8).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 13205/2000, 13207/2000 (LWU).

*Ecology* : Terrestrial, grows on soil covered rocks in wet condition.

*Distribution* : Endemic to India (Udar & Kumar, A. 1981a).

*Status in Palni hills* : Vulnerable. New record for Kodaikanal (Palni hills).

**21. *Notoscyphus pandei* Udar & A. Kumar**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Shembaganur; 13016/2000, 13029/2000 (LWU).

*Ecology* : Terrestrial, grows on the soil surface along road sides in shady places.

*Distribution* : Endemic to India (Udar & Kumar, A. 1981a).

*Status in Palni hills* : Vulnerable. New to the region.

**22. *Notoscyphus paroicus* Schiffn.**

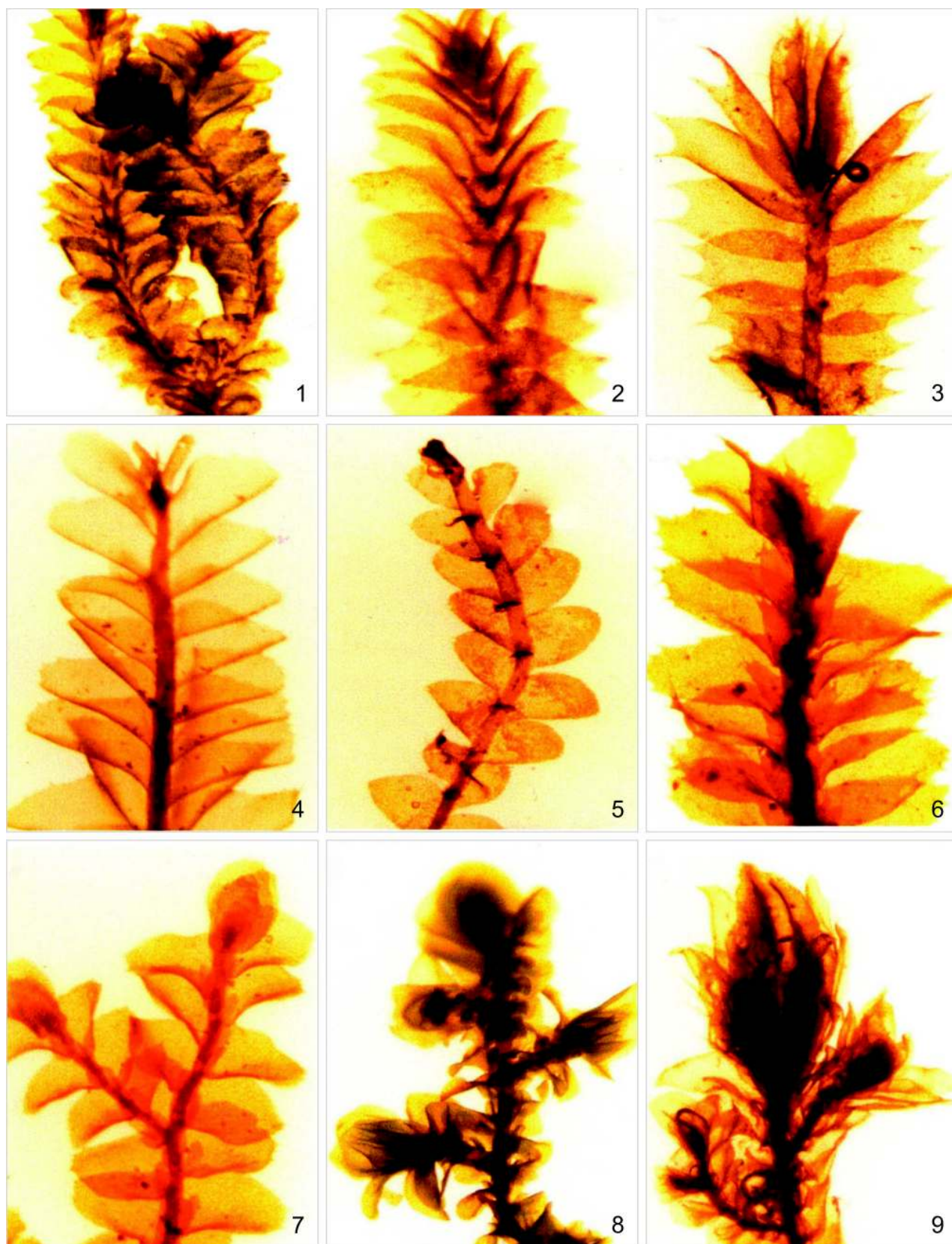
*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Shembaganur; 13005/2000 (LWU).

*Ecology* : Terrestrial, grows on the soil surface along road sides in shady places.

*Distribution* : Asia – India, Indonesia, Japan, Sri Lanka (see also Udar & Kumar, A. 1981a).

*Status in Palni hills* : Vulnerable. New record for Kodaikanal (Palni hills).





**Plate 2.** 1. *Lophocolea muricata* ( $\times 11$ ); 2. *Lophocolea heterophylla* ( $\times 9$ ), 3. *Lophocolea bidentata* ( $\times 10$ );  
4. *Plagiochila nepalensis* ( $\times 10$ ); 5. *Calypogeia azurea* ( $\times 11$ ); 6. *Porella perrottatiana* ( $\times 12$ );  
7. *Porella campylophylla* ( $\times 12$ ); 8. *Frullania ericoides* ( $\times 13$ ) and 9. *Frullania acutiloba* ( $\times 12$ ).

## GEOCALYCACEAE

**23. *Heteroscyphus argutus* (Reinw., Blume & Nees) Schiffn. (Plate :1; Fig. : 7).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Perumalmalai; 7212/1983, 7299/1983 (LWU).

*Ecology* : Terrestrial, grows on soil and rocks in shady places.

*Distribution* : Australia, New Zealand, Papua New Guinea, Hawaii, India, Indonesia, Malaysia, Nepal, China, Japan, Korea (see Srivastava & Srivastava; 2002).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**24. *Heteroscyphus orbiculatus* Abha Srivast. & S. C. Srivast. (Plate : 1; Fig.:9)**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Shembaganur; 7403/1983 (Type : LWU), 20110-112/2006 (LWU).

*Ecology* : Terrestrial grows on soil covered rocks.

*Distribution* : Endemic to India (Srivastava & Srivastava; 2002).

*Status in Palni hills* : Rare in Kodaikanal (Palni hills).

**25. \**Heteroscyphus palniensis* Abha Srivast. & S. C. Srivast.**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : 246/1966 (Type : LWU).

*Ecology* : Terrestrial, grows on soil covered rocks.

*Distribution* : Endemic to India (Srivastava & Srivastava, 2002).

*Status in Palni hills* : Rare in Kodaikanal.

**26. *Lophocolea bidentata* (L.) Dumort. (Plate : 2; Fig. :3).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Shembaganur; 13015/2000, 13030/2000, 13039/2000 (LWU).

*Ecology* : Grows as terricolous as well as corticolous, in moist and shady conditions.

*Distribution* : Australia, New Zealand, Africa-Cameroon, Madagascar, Nyasaland, South Africa, Reunion, Southern Africa including Uganda; North America-U.S.A. (Alaska etc.), Canada (British Columbia), Central America-Cuba, Mexico, Venezuela, Atlantic Islands, Austria, Azores, Bulgaria, Corsica, England, Finland, France, Germany, Hungary, Ireland, Italy, Madeira, Mediterranean Islands, Morocco, Norway, Portugal, Scandinavia, Switzerland, Slovak; Japan, Asia minor, Bhutan, China, India, Nepal (see Kim & al., 1995; Long & Grolle, 1990; Srivastava & Srivastava, 2002).

*Status in Palni hills* : Common.

**27. *Lophocolea heterophylla* (Lehm.) Nees (Plate : 2; Fig. : 2).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Shembaganur; 13000/2000, 13006/2000, 13031/2000, 13025/2000, 20083/2006, 20083/2006, 20086/2006 (LWU).

*Ecology* : Grows as terricolous as well as corticolous, in moist and shady conditions.

*Distribution* : Africa, Canada, U.S.A., CIS (Siberia), Altas mountain, Luxembourg, Norway, Sweden, Finland, Scotland, Portugal, Italy, Romania, Bulgaria, Japan, Manchuria, Azores, Canaries, Madeira, Netherlands; China, Philippines, India, Nepal (see Bates & al., 1997; Schuster, 1980; Srivastava & Srivastava, 2002).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**28. *Lophocolea muricata* (L.) Dumort. (Plate : 2; Fig. :1).**

*Specimens examined* : South India : Tamil Nadu – Palni hills- Kodaikanal (Kodai lake, Shembaganur) (see also Srivastava & Srivastava, 2002).

*Ecology* : Grows as terricolous as well as corticolous, in moist and shady conditions.

*Distribution* : Australia, Fiji Isl., New Zealand, Papua New Guinea, New Zealand Tasmania, Africa- Burundi, Cameroon, Ethiopia, Mozambique, South Africa, Tanzania, Uganda, Zaire, Zimbabwe, North America (Southern Appalachian and north Carolina), South America- Brazil, Chile, Colombia, Patagonia, Venezuela, West Indies, India, Indonesia (Java) (see also Srivastava & Srivastava, 2002; Wigginton & Grolle, 1996; Yamada, 1990; Yano, 1995).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

#### PLAGIOCHILACEAE

##### 29. *Plagiochila elegans* Mitt. (Plate :2; Fig. :4).

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : 17047/2003 (LWU).

*Ecology* : Plants grow as corticolous, in moist and shady habitat.

*Distribution* : Bhutan, China, India, Nepal (see Inoue, 1964; Long & Grolle, 1990; So, 2001a; So & Grolle, 2000; Rawat & Srivastava, 2007).

*Status in Palni hills* : New record for the Palni hills.

##### 30. *Plagiochila indica* Mitt. & Steph.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : Shembaganur; 13168/2000, 20080/2006, 20092/2006, 20117/2006, 20129/2006 (LWU).

*Ecology* : Plants grow as corticolous, in moist and shady conditions in pure population.

*Distribution* : India, Thailand (Inoue, 1974a; So & Grolle, 2001; Rawat & Srivastava, 2007).

*Status in Palni hills* : Common. New record for the Palni hills.

##### 31. *Plagiochila nepalensis* Lindenb. (Plate : 2; Fig. : 5).

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Silver Cascade : 12949/2000 (LWU).

*Ecology* : Plants grow as corticolous, in moist and shady conditions in pure population

*Distribution* : Bhutan, China, India, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam, Japan (see Inoue, 1967; So & Grolle, 2000; Srivastava & Dixit, 1994; Rawat & Srivastava, 2007).

*Status in Palni hills* : Common.

##### 32. *Plagiochila peradenyensis* Schiffn.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Silver Cascade : 12995/2000 (LWU).

*Ecology* : Plants grow as corticolous, in moist and shady habitat.

*Distribution* : India, Sri Lanka (Srivastava & al., 2002; Rawat & Srivastava, 2007).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

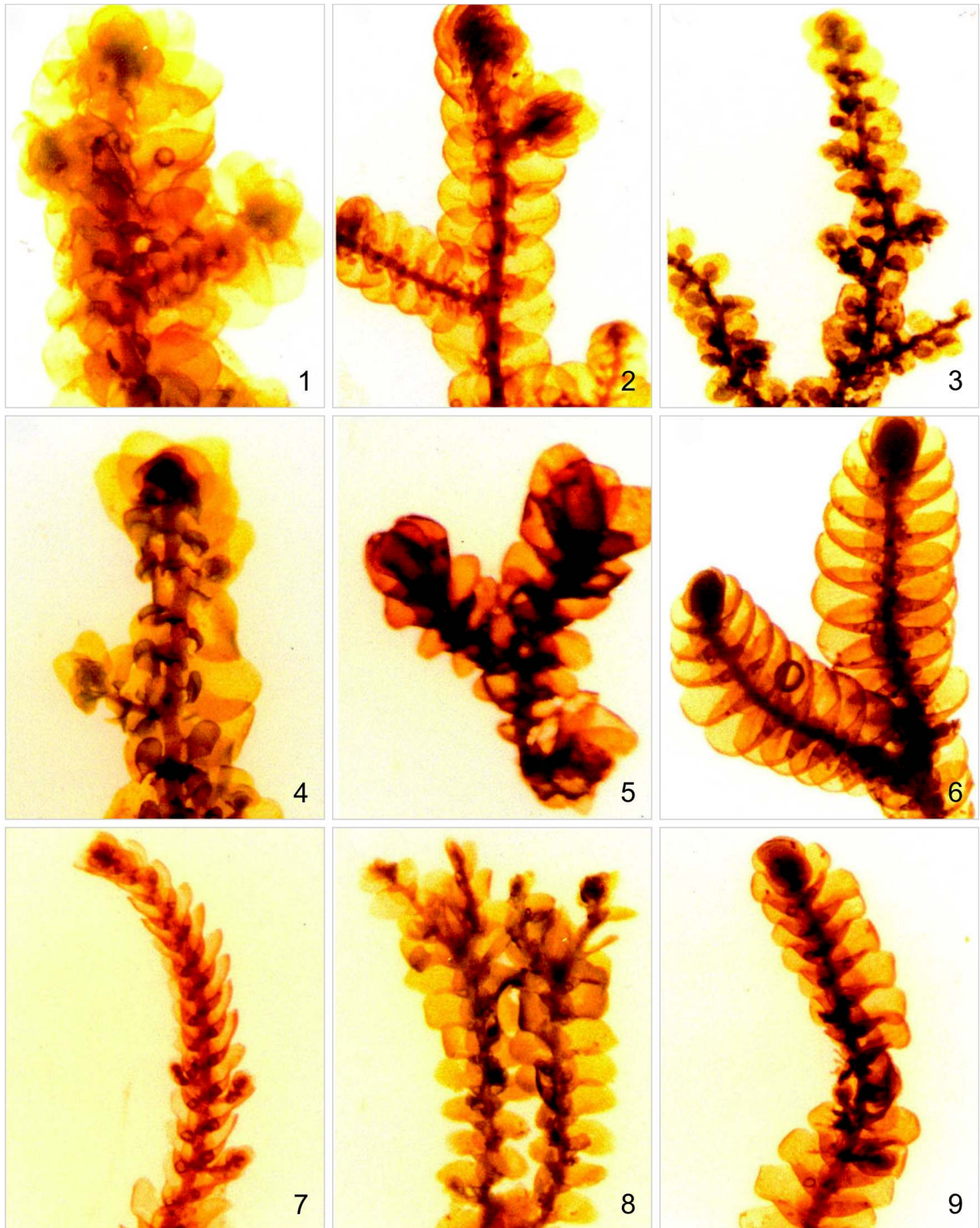
#### LEPIDOZIACEAE

##### 33. \**Bazzania tridens* (Reinw., Blume & Nees) Trevis.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : 199 S/1971 (LWU).

*Ecology* : Terrestrial, growing on soil covered rocks, in crevices, on sloppy cliffs, loosely fixed with the substratum commonly grows in association of *Cephaloziella* sp., *Dumortiera hirsuta*, *Herbertus* sp., *Heteroscyphus* sp. and *Notoscyphus* sp.





**Plate 3.** 1. *Frullania arecae* ( $\times 13$ ); 2. *Frullania tamarisci* var. *obscura* ( $\times 14$ ), 3. *Frullania campanulata* ( $\times 15$ ); 4. *Frullania neurota* ( $\times 11$ ); 5. *Lopholejeunea subfusca* ( $\times 13$ ); 6. *Leucolejeunea xanthocarpa* ( $\times 9$ ); 7. *Lejeunea discareta* ( $\times 13$ ); 8. *Lejeunea flava* ( $\times 14$ ) and 9. *Cheilolejeunea imbricata* ( $\times 10$ ).

*Distribution* : India, Nepal, Sri Lanka, Taiwan, China, Japan, Korea, North America, Europe, Azores, Caucasus, Guatemala (see Sharma & Srivastava, 1993).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

#### CALYPOGIACEAE

### 34. *Calypogeia azurea* Stotler & Crotz. (Plate :2; Fig. : 6).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Silver Cascade : 7349/1983, 12966/2000, 12967/200, 20120/2006 (LWU).

*Ecology* : Commonly terrestrial, growing on soil covered rocks, rarely on humus, associated with *Heteroscyphus* sp., *Jungermannia* sp.

*Distribution* : India, Japan, CIS, Taiwan, Britain, Denmark, Feroe Islands, France, Germany, Hungary, Netherlands, Italy, Portugal, Spain, Sweden, Switzerland, Mexico (see also Sharma & Srivastava, 1993).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

#### CEPHALOZIACEAE

### 35. *Cephaloziella kiaerii* (Austin) Arnell

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 12935/2000, 12936/2000, 13014/2000, 13015/2000, 20086/2006 (LWU).

*Ecology* : Terrestrial, growing on soil covered rocks, in crevices, on sloppy cliffs commonly grows in association of *Notoscyphus* sp.

*Distribution* : Africa, Bhutan, Sri Lanka, China, India, Indonesia, Madagascar, Malaysia, Mozambique, New Caledonia, Papua New Guinea, Philippines, Tanzania, Thailand, Zaire, Zimbabwe (Udar & Kumar, A., 1985).

*Status in Palni hills* : Common.

#### CEPHALOZIACEAE

### 36. *Cephalozia hamatiloba* Steph.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 209 S/1971, 13499/2000, 20086/2006, 20087/2006 (LWU).

*Ecology* : Terrestrial, growing on soil covered rocks, loosely fixed with the substratum commonly grows in association of *Cephaloziella* sp., *Heteroscyphus* sp. and *Notoscyphus* sp.

*Distribution* : Bhutan, India, Thailand (Bapna & Kachroo, 2000; Udar & Kumar, A. 1982).

*Status in Palni hills* : Rare in Kodaikanal (Palni hills).

#### PORELLACEAE

### 37. *Porella campylophylla* (Lehm. & Lindenb.) Trevis. (Plate :2; Fig. : 7).

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Silver Cascade : 12996/2000 (LWU).

*Ecology* : Corticolous, grows under tree canopy as pendent.

*Distribution* : Bhutan, India, Laos, Cambodia, Vietnam, China, Nepal (Hattori, 1978; Udar & Shaheen, 1983 a, b).

*Status in Palni hills* : New record for Palni hills.

### 38. *Porella perottetiana* (Mont.) Trevis.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 6842/1954, 2901 S/1971 (LWU).

*Ecology* : Corticolous, grows under tree canopy as pendent.

*Distribution* : Bhutan, India, Cambodia, Vietnam, Laos, Myanmar, Philippines, Sri Lanka, Taiwan, Japan, China (see Hattori, 1967, 1969, 1975b, 1978; Hong, 2003; Yamada & al., 1981; Yamada & Choe, 1997; Udar & Shaheen, 1983a, b).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

#### JUBULACEAE

### 39. *Frullania acutiloba* Mitt. (Plate : 2; Fig. : 8).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : 133 S/1971, 13190/2000, 13212/2000, 20084/2006 (LWU).

*Ecology* : Corticolous, grows under moist as well as exposed conditions.

*Distribution* : India, Indonesia, Sri Lanka (see also Hattori, 1979; Mitten, 1861; Srivastava & Alam, 2002).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

### 40. *Frullania arecae* (Spreng.) Gottsche. (Plate : 3; Fig. : 1).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 13161/2000, 13162/2000, 13179/2000, 13189/2000, 13191/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as exposed conditions.

*Distribution* : Australia, New Guinea, Norfolk islands, Pacific islands, Bioko, Burundi, Cameroon, Ethiopia, Ghana, Mozambique, Madagascar, Reunion, Rwanda, Brazil, Columbia, Ecuador, Galapagos Isl., Panama, Venezuela, China, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, Thailand (see Wigginton & Grolle, 1996; Yamada & al., 1981; Yuzawa, 1983; 1991; Yuzawa & Koike, 1994; Srivastava & Alam, 2002).

*Status in Palni hills* : Vulnerable. New to Kodaikanal (Palni hills).

### 41. *Frullania campanulata* Taylor (Plate : 3; Fig. : 3).

*Specimens examined* : Palni hills – Kodaikanal- Shembaganur : 127 S /1971, 20088/2006 (LWU).

*Ecology* : Corticolous, grows under moist as well as exposed conditions.

*Distribution* : India, Indonesia, Sri Lanka (see Hattori, 1974b; Onraedt, 1981; Srivastava & Alam, 2002).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

### 42. *Frullania ericoides* (Nees) Mont. (Plate :2; Fig. : 9).

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 12918/2000, 13073/2000, 13219/2000, 20082/2006 (LWU).

*Ecology* : Corticolous, grows under moist as well as exposed conditions.

*Distribution* : Australia, New Caledonia, Papua New Guinea, Arabian Peninsula; Angola, Ascension Island, Annobon, Bioko (Fernando Po), Burundi, Cameroon, Central African republic, Congo, Cape Verde Isl., Ethiopia, Gambia, Guinea, Kenya, Madagascar, Malawi, Mozambique, Nigeria, Principe, Reunion, Rwanda, Seychelles, South Africa, Sierra Leone, Scotia, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe; Canada, United States of America, Brazil, Venezuela, Galapagos Isl.; Antilles, Caribbean Isl., Mexico, Bhutan, India, Indonesia, Nepal, Philippines, China, Taiwan, Vietnam, Korea, Japan; Europe (see Fischer, 1993; Nath & Asthana, 1998; Srivastava & Alam, 2002).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

### 43. *Frullania muscicola* Steph.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 12920/2000, 13195/2000 (LWU).

*Ecology* : Corticolous, grows under moist and shady as well as exposed conditions.

*Distribution* : Japan, Korea, Northern China, Mongolia; CIS, India, Nepal, Taiwan (see Hattori & al., 1977; Hattori & Lin, 1985; Vana & Ighatov, 1995; Yamada and Choe, 1997; Srivastava & Alam, 2002).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**44. *Frullania neurota* Taylor (Plate : 3; Fig. : 4).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 12945/2000, 13204/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as exposed conditions.

*Distribution* : Africa, Hawaii, Jamaica, Mexico, Brazil, Colombia, Surinam, Bhutan, China, India, Indonesia, Nepal, Sri Lanka, China, Thailand, Vietnam (see Hattori, 1979; Hattori & Lin, 1985; Yuzawa, 1991; Srivastava & Alam, 2002).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**45. \**Frullania tamarisci* var. *obscura* (L.) Dumort. (Plate :3; Fig. : 2).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 136 S /1972, 137 S/1972 (LWU).

*Ecology* : Corticolous, grows under moist as well as exposed conditions.

*Distribution* : China, India, Indonesia, Philippines, Sri Lanka, Taiwan, Asia Minor, CIS, Japan, Korea, China (see also Hattori & Lin, 1985; Yamada & Choe, 1997; Srivastava & Alam, 2002).

*Status in Palni hills* : Rare in Kodaikanal (Palni hills).

LEJEUNEACEAE

**46. *Cololejeunea cardiocarpa* (Mont.) Steph.**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 13207/2000 (LWU).

*Ecology* : Corticolous and epiphyllous, grows under moist, humid and wet conditions.

*Distribution* : Australia, Burundi, Cameroon, Kenya, Madagascar, South Africa, Sierra Leone, Swaziland, Tanzania, Uganda, Zaire, Zimbabwe, Antilles, Bahamas, Cuba, Guadalupe, Mexico, Puerto Rico; Brazil, Galapagos Isl., India (Grolle, 1995; Schuster, 1980; Yano, 1995; Wigginton & Grolle, 1996; Asthana & Srivastava, 2003).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**47. *Cheilolejeunea imbricata* (Nees) S. Hatt. (Plate : 3; Fig. : 9).**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 13196/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Bonin Isl., Papua New Guinea, India, Indonesia, Philippines, Taiwan, Thailand, Japan, Korea (see also Asthana & al., 1995; Hong, 2003; Piippo, 1990; Streimann, 1991).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**48. *Lejeunea aloba* Sande Lac.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Silver Cascade : 7342/1982, 7437/1983, 7461/1983, 7480/1983, 7577/1983, 7615/1983, 12996/2000, 13195/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Samoa, Zaire, India, Indonesia (see also, Agarwal, 1986; Grolle & Wigginton, 1996).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**49. *Lejeunea discreta* Lindenb. (Plate : 3; Fig. : 7).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Silver Cascade : 14272/1909 (G) ; 12999/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Norfolk Isl., New Caledonia, Papua New Guinea, Japan, Korea, Bhutan, Cambodia, China, India, Indonesia, Malaysia, Moluccas, Nepal, Sri Lanka, Taiwan (see Grolle, 1982; Mizutani, 1971; Piippo, 1990; Yamada & Choe, 1997; Zhu & So, 2001).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**50. *Lejeunea flava* (Sw.) Nees (Plate : 3; Fig. : 8).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 198 S/1971, 202 S/ 1971, 13003/2000, 13180/2000, 13181/2000, 13181/2000, 13186/2000, 13187/2000, 13194/2000, 20091/2006, 20096/2000, 20096/2006, 20102/2006, 20104/2006, 20104/2006, 20106/2006 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Australia, New Zealand, New Caledonia, Papua New Guinea, Samoa, Central African Republic, Congo, Ethiopia, Ghana, Kenya, Madagascar, Rwanda, South Africa, Sierra Leon, Tanzania, Uganda, Zaire, Zambia, India, Indonesia, Malaysia, Nepal, Sri Lanka, China, Thailand, Japan, Korea, Mongolia, Europe, Azores, Madeira, Bahamas, Bermuda, Cuba, Guadalupe, Guatemala, Honduras, Jamaica, Panama, Puerto Rico, Virgin Isl., Trinidad, Venezuela, U.S.A. (see also Mizutani, 1964; Schuster, 1957, 1980; Wigginton & Grolle, 1996; Zhu & So, 2001; Gupta & Udar, 1986).

*Status in Palni hills* : Very Common.

**51. \**Lejeunea neelgherriana* Gottsche.**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 7342/1982 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Bhutan, India, Nepal, Sri Lanka, Korea (Hong, 2003; Long & Grolle, 1990; Yamada & Choe, 1997; Zhu & So, 2000, 2001).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**52. *Lejeunea perrottetii* Steph.**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Kodai Lake : 7693/1983 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Endemic to India (Agarwal, 1986).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**53. \**Lejeunea tenerima* Lindenb.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 138 S/1971 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Endemic to India (South India) (see Agarwal, 1986)

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**54. *Lejeunea wightii* Lindenb.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 7400/1983, 7413/1983, 7583/1983, 13005/2000, 13164/2000 (LWU).



*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Endemic to India (See Bapna & Kachroo, 2000).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**55. *Leucolejeunea xanthocarpa* (Lehm. & Lindenb.) A. Evans (Plate : 3; Fig. : 6).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 13210/2000 (LWU).

*Ecology* : Corticolous, grows under moist and shady conditions.

*Distribution* : Papua New Guinea, Bioko, Cape of Good hope, Ethiopia, Kenya, Madagascar, Mozambique, Rwanda, South Africa, St. Helena, Tanzania, Uganda, Zaire, Zimbabwe, Brazil, Colombia, Galapagos Isl., Puerto Rico, Venezuela; Bahamas, Guyana, Guadeloupe, Jamaica, New Providence, Maidenhead, Mexico, Trinidad, United States of America, Bhutan, Celebes, India, Indonesia, Malaysia, Sri Lanka, Philippines, Japan, Korea, China, Mangolia (Gradstein 1997; Grolle & Piippo, 1984; Menzel, 1988; Piippo, 1990; Schuster, 1980; Stephani, 1911; Yano, 1995; Wigginton & Grolle, 1996; Zhu & So, 1996, Udar & Awasthi, 1983).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**56. *Lopholejeunea sikkimensis* Steph.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 137 S/1971, 13012/2000 (LWU).

*Ecology* : Corticolous, grows under moist, wet and shady conditions.

*Distribution* : Endemic to India (Awasthi & al., 2000).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**57. *Lopholejeunea subfusca* (Nees) Steph. (Plate : 3; Fig. : 5).**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 13198/2000 (LWU).

*Ecology* : Corticolous, grows under moist and shady conditions.

*Distribution* : Endemic to India (Awasthi & al., 2000).

*Status in Palni hills* : New and vulnerable in Kodaikanal (Palni hills).

**58. *Microlejeunea ulicina* (Taylor) A. Evans (Plate : 1; Fig. : 7).**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 416-445/1962, 384-409/1966, 198-200 S/ 1971, 12963/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Ivory Coast, U.S.A., Canada, Brazil, Chili, Japan, Azores, Britain, France, Italy, Luxembourg, Madeira, Canary Isl., India (see Aleffi & al., 1998; Gonzalez- Macebo & Losada-Lima, 2003; Werner, 1993; Yamada & al., 1981; Verma, 2005).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**59. *Schiffneriolejeunea polycarpa* (Nees) Gradst.**

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shembaganur : 13014/2000 (LWU).

*Ecology* : Corticolous, grows under moist as well as dry conditions.

*Distribution* : Angola, Central African republic, Congo, Fernando Po, Ghana, Guinea, Mozambique, Nigeria, Sao Tome, Sierra Leone, Tanzania, Zaire, Zambia, Zimbabwe, Brazil, Puerto Rico, India, Sri Lanka (see Gradstein & Inoue, 1980; Yano, 1995; Wigginton & Grolle, 1996; Udar & Awasthi, 1983).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

#### RADULACEAE

##### 60. \**Radula kurzii* Steph.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : 8222 (G).

*Ecology* : Corticolous, grows on tree barks.

*Distribution* : India, Sri Lanka. (Bapna & Kachroo, 2000).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

##### 61. \**Radula meyeri* Steph.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Shenbaganur : 5792/ 1982 (LWU).

*Ecology* : Corticolous, grows on tree barks.

*Distribution* : India, East and West Africa (see Udar & Kumar, D., 1982; Bapna & Kachroo, 2000).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

##### 62. \**Radula tabularis* Steph.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 132 S/1971 (LWU).

*Ecology* : Corticolous, grows on tree barks.

*Distribution* : India, Australia, New Zealand, Mascarene Island, South Africa (Bapna & Kachroo, 2000).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

#### ORDER : MARCHANTIALES

#### CLEVEACEAE

##### 63. \**Athalamia pusilla* (Steph.) Kashyap

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- 1960 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks.

*Distribution* : India, Nepal (Udar & Srivastava, 1965).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

#### AYTONIACEAE

##### 64. \**Asterella khasyana* (Griff.) Pande & al.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 12927/2000 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks, also on exposed rocks

*Distribution* : India, Indonesia, Thailand (Bapna & Kachroo, 2000; Alam, 2005).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

##### 65. \**Mannia foreau* Udar & V. Chandra

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal : B5745/1962 ((LWU).

*Ecology* : Terrestrial, grows on moist soil and soil covered rocks.

*Distribution* : Endemic to India (Udar & Chandra, 1965; Bapna & Kachroo, 2000).

*Status in Palni hills* : Endangered in Kodaikanal (Palni hills).

**66. Plagiochasma cordatum.** Lehm. & Lindenb.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 158 S/1972, 12923/2000, 20089/2006 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks, also on exposed rocks.

*Distribution* : Afghanistan, Bhutan, China, Hawaii, India, Nepal, Taiwan. (Bapna & Kachroo, 2000; Alam, 2005).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**67. Plagiochasma rupestre** (J. R. Forst. & G. Forst.) Steph.

*Specimen examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 20093/2006 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks, also on exposed rocks.

*Distribution* : Greece, Italy, Portugal, Tunisia, Turkey, Yugoslavia, Australia, New Zealand, India, Iran, Nepal, Taiwan, Sri-Lanka. Ethiopia. (Bapna & Kachroo, 2000; Alam, 2005).

*Status in Palni hills* : New record for Kodaikanal (Palni hills).

**68. Reboulia hemisphaerica** (L.) Raddi.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 12933/2000, 12992/2000 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks, also on exposed rocks.

*Distribution* - Asia Minor, Caucasus, India, Indonesia, Japan, Korea, Nepal, South Africa, Australia, New Zealand, Mexico, Brazil, Europe. (see Udar & Chandra, 1964b; Bapna & Kachroo, 2000).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

LUNULARIACEAE

**69. Lunularia cruciata** (L.) Dumort.

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 12927/2000, 12937/2000, 12958/2000, 13183/2000, 13184/2000, 20101/2006, 20107/2006 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks.

*Distribution* : Abyssinia, Australia, Europe, India, Japan, Norway, S. Africa (Bapna & Kachroo, 2000; Alam, 2005).

*Status in Palni hills* : Common.

MARCHANTIACEAE

**70. Dumortiera hirsuta** (Sw.) Nees

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 12957/2000, 12984/2000 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks and also on exposed rocks.

*Distribution* : Africa, Europe, Hawaii, India, Japan, N. America, Nepal, New Zealand, S. America (Srivastava & Sharma, 1987; Bapna & Kachroo, 2000).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

**71. *Marchantia paleacea* Bertol.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 12954/2000, 12955/2000, 12956/2000 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks and often on exposed rocks.

*Distribution* : Afghanistan, Africa, Azores, Bhutan, Brazil, China, Europe, Guatemala, Hawaii, India, Italy, Japan, Indonesia, Nepal, N. America, S. America, New Zealand, Pakistan, Somoa, Tahiti (Bapna & Kachroo, 2000; Alam, 2005).

*Status in Palni hills* : New record for Kodaikanal (Palni hills); vulnerable.

**72. *Marchantia palmata* Nees**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 156 S/1971, 12941/2000, 12984/2000 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks and also on exposed rocks.

*Distribution* : Sri Lanka, China, Europe, India, Japan, Indonesia, New Guinea, Pakistan, Tonkin (Bapna & Kachroo, 2000; Alam, 2005).

*Status in Palni hills* : Vulnerable in Kodaikanal (Palni hills).

## TARGIONIACEAE

**73. *Targionia hypophylla* L.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 12926/2000, 12923/2000, 12928/2000, 12929/2000, 12930/2000, 12938/2000, 13041/2000, 13060/2000, 13061/2000, 20093/2006 (LWU).

*Ecology* : Terrestrial, grows on wet soil and soil covered rocks.

*Distribution* : China, India, Japan, Korea, Taiwan, Australia, New Zealand, Africa, Chile, Ecuador, Madagascar, Hawaii, Peru, Tenerife (Udar & Gupta, 1983; Bapna & Kachroo, 2000).

*Status in Palni hills* : New record for Kodaikanal (Palni hills); common.

## RICCIACEAE

**74. *Riccia fluitans* L.**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 13040/2000, 13058/2000, 13059/2000 (LWU).

*Ecology* : Terrestrial, grows on extremely wet soil and soil covered rocks, often in water.

*Distribution* : Bangladesh, China, India, Indonesia, Japan, Korea, Malaysia, Nepal, CIS, Australia- New Zealand; Britain, West Indies; Argentina, Brazil (Pande & Udar, 1958; Bapna & Kachroo, 2000).

*Status in Palni hills* : New record for Kodaikanal (Palni hills); vulnerable.

**75. \**Riccia grollei* Udar**

*Specimens examined* : South India : Tamil Nadu - Palni hills – Kodaikanal- Perumalmalai : 424/1962 (LWU).

*Ecology* : Terrestrial, grows on soil and soil covered rocks.

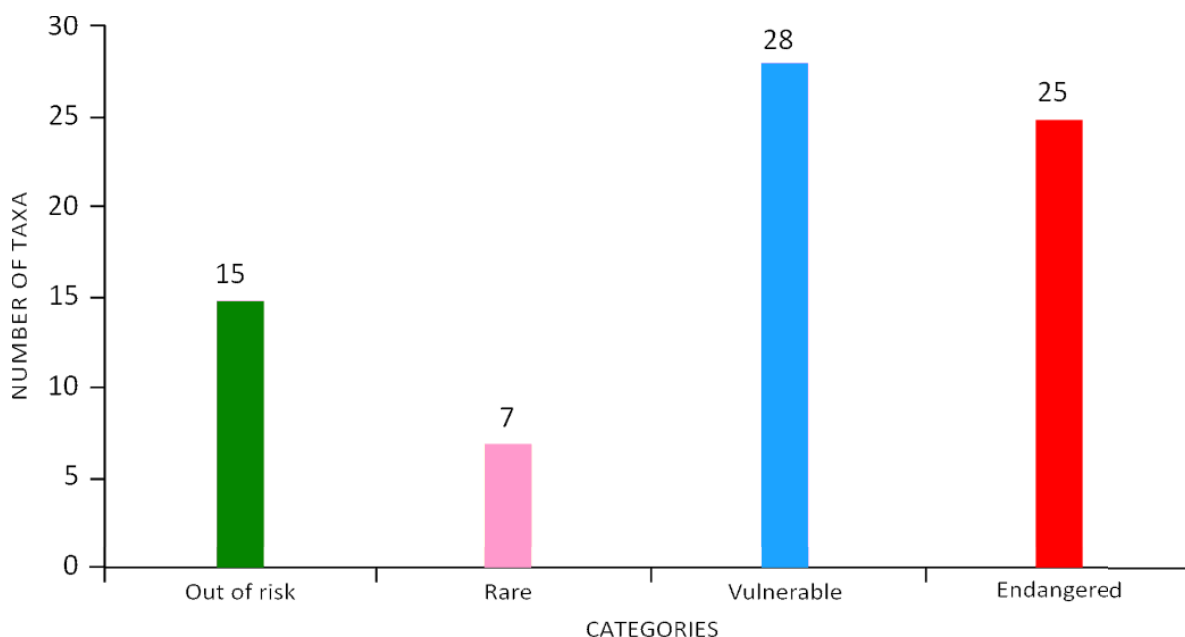
*Distribution* : Endemic to India (Pande & Udar, 1958; Bapna & Kachroo, 2000).

*Status in Palni hills* : Endangered in Kodaikanal.

## DISCUSSION

Tropical and subtropical rain forests host various biotic communities, holding about 50% of the global species, but population density of individual is very low. Such forests also host a large number of endemic-native species found only in these locations. Rarity is a multifaceted concept and species can show different degree of rarity at global, regional and local levels. Any individual become rare either by unfavourable ecological niche or by man made disturbance. Poorly dispersing species become vulnerable due to habitat loss and its fragmentation. (see also Poćs, 1982; Smith, 1982).

An assessment of current status of hepatic diversity in and around Kodaikanal in Palni hills revealed the presence of 36 genera and 75 species falling under 3 orders and 22 families. Of these 33 species are corticolous epiphytes, 38 species are terricolous and 4 species occur as both corticolous as well as terrestrial. This data is an outcome of investigations on several past and recent collections as well as those previously reported from this region. Of these only 68 species are at lower risk in the region (**Fig. 1**).



**Fig. : 1.** Distribution of Taxa under different categories in Palni hills.

The rarity of 7 species (4 terricolous and 3 corticolous) in Palni hills may be attributed to habitat destruction and degradation due to various reasons like tea and coffee plantation, uncontrolled grazing, increased tourism, etc. making the survival of these plants highly vulnerable. A couple of endemic species, *Fossombronia foreaui* Udar & S.C. Srivast. (Srivastava & Udar, 1975b) and *Mannia foreaui* Udar & V. Chandra (Udar & Chandra, 1965) described from Palni hills were never recollected from the area after their original discovery. A species which has declined to low numbers tend to suffer from loss of genetic diversity, reducing the potential for adaptation to changing environmental conditions. In this connection Mackenzie & al. (1999) rightly remarked that a minimum viable population (MVP) is required for a long term survival of species to ensure maintenance of genetic variability. There is a further need to assess the entire bryo-diversity of the area including mosses, liverworts and hornworts.

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## पलनी पहाडियों ( तमिलाडु, दक्षिण भारत ) में लिवरवर्ट विविधता - एक चेक लिस्ट

अफरोज आलम एवं एस.सी.श्रीवास्तव

### सार संक्षेप

वर्तमान अन्वेषण कोदड़कनाल एवं निकटवर्ती अंचल में लिवरवर्ट के 75 टैक्सा की व्याप्ति दर्शाते हैं। प्रत्येक जाति एक्सिकेट, पारिस्थितिकी, व्याप्ति श्रेणी तथा अध्ययन के अंचल में उसकी स्थिति के विवरण के साथ सूचीबद्ध की गई है।

## TRADITIONAL HERBAL REMEDIES USED IN SIKKIM, INDIA

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### ABSTRACT

The paper deals with the 225 different uses of 167 plant species belonging to 84 families for the treatment of 27 major ailments among ten rural communities of Sikkim. All the gathered information were based on the herbal practices of selective representative villages of Sikkim. During the collection of information, traditional uses pattern, parts used for, mode of preparation and administration of doses were also discussed. Out of the total uses of plants, herbs constitute c. 50% , trees by 25% and shrubs by 17%, while climbers constitutes the lowest habitat category (8%). Most herbal medicines were used in the form of paste of the plant or of a particular part. The other modes of uses were decoction, powder or inhalations etc. Remedies for common ailments were known to all households, while medicines or doses for critical ailments were taken as per the advice of the herbal healers or *Jakris*. The present study also indicated that the region harbors a high diversity of medicinal plants. A list of 167 plant species along with their Local name, habit, flowering and fruiting period, plant part/s used, medicinal properties and the mode of use are also enumerated.

**Keywords:** Herbal remedy, Medicinal plants, Traditional knowledge.

### INTRODUCTION

The traditional societies throughout the world possess vast knowledge regarding the use of plants. Folk medicines constitute the basic parameter to develop the modern health care system (Balick & Cox, 1996). About 64% of the global population depends directly on traditional medicines for their health care system (Farnsworth, 1994; Steenkamp, 2003; Sheldon & al., 1997); while in India about 75-80% of population depends upon the traditional folk medicines (Hebbar & al., 2004; Nagarguna & Rao, 1990; Jain & al., 2004; Jain & Saklani, 1991; Katewa & al., 2004; Dash & Mishra, 1998, 2002). Majority of folk medicines have remained confined to certain region or to certain tribes of India (Dash, 1994).

The traditional knowledge of medicinal plants survives only by words of mouth from generation to generations (Dash & Misra, 1997; Shrestha & Dhillion, 2003; Figueiredo & al., 1993; Tabuti & al., 2003). Till today the different methods of preparation of drugs, dosages etc. have remained secret to a family or clan. Unfortunately, such valuable knowledge are vanishing rapidly due to the change of cultural values of traditional societies (Caniago and Siebert, 1998) and non exchange of ideas and exposure to modern health care systems (Plotkin, 1988; Leach, 1994; Dash, 1994).

Traditional use of plants is a part of the cultural heritage of the people in Sikkim (Hajra & Chakraborty, 1981; Bennet, 1983, 1985; Krishna & Singh, 1987; Kumar & al., 1994; Rai & Sharma, 1994; Singh & Chauhan, 1997; Jana & Chauhan, 2000). Traditional herbal healers in Sikkim are known as *Lamas* (The monastery heads) or *Jakris* by the local people. Mostly the plants are recommended by the elderly people of the village or the headman of the monastery. All the herbal healers do not recommend medicines for all ailments, but there are different specialists for recommending different diseases and persons, for example, *Jakris* specialize in children diseases and medico religious problems, *Lamas* expertise in woman and other herbal remedies. Not only the rural mass but also the good number of urban population also depends on the herbal remedies in Sikkim (Dash & al., 2003). Most interestingly, one plant may be used for different remedies in different combinations and different doses. The present paper emphasizes the traditional uses of plants by the different tribes of Sikkim for treating different ailments.

## STUDY AREA

The state of Sikkim one of the smallest north-east States of India is situated in the Western flank of Eastern Himalaya and lies in between 27°10" to 28°9" N and 87°59" to 88°56" E. This encompasses an area of 7096 sq km. The State is bounded by Nepal in the West, Bhutan in the South-east, Tibet in the North and the districts of Darjeeling (West Bengal) in the South. The mountain chains which run southward from the main Himalayan ranges form the natural boundaries of Sikkim. The area is inhabited by number of ethnic groups including its aboriginals *Lepchas*, *Bhutia*, *Nepali*, *Limbu*, *Serpa*, *Sikkimese* communities. Wide range of topography, varied climatic condition and high annual precipitation makes the state of Sikkim one of the richest phyto-geographic regions of India. Above 44.07% of the total geographic area of the state is under forest, out of which 34.16% (2424 sq km) is under dense forest cover and 9.91 % ( 703 sq km) is under open forest. It is estimated that about more than 26% of the flowering plants of India are found in this 0.2% of the total geographic region of the country. (Dash & Singh, 2002). About 5000 species of vascular plants occur in this region (Singh & Chauhan, 1999).

### *The Villages*

The field study was carried out in the villages of Rongli, Phodomchen and Gnathang of East district; Yuksum and Ravangla of West district; Lachen, Lachung and Chungthang of North district; Namchi and Tendong of south district. The elevation of the selected villages ranges from 1500 to 3700 m. Rongli and Namchi situated at 1500 m, Phodomchen, Chungthang and Yuksum situated at 2000 m, Lachen and Lachung situated at 2400 - 2600 m, while Gnathang situated at 3700 m height. In all the villages different ethnic communities dominated. The terrain is characterised by steep hill slopes or valleys and the households are scattered and consisting of hamlets. The climate of the area is characterised by a prolonged winter and rainy season with a short and pleasing summer. The state receives rainfall of 200 - 500 cm. Lower hills and valleys enjoys a subtropical climate, warm in winter, hot and humid in summer.

### *Vegetation of the Area*

Depending upon the altitudinal variation, the vegetation of the State can be divided in to the tropical (up to 900 m), sub-tropical (900 - 1500), temperate (1500 - 3500 m) and alpine (3500-4500 m). All the studied villages fall between the subtropical to sub-alpine regions. Sub tropical vegetation is mixed and comprises of *Adina cordifolia*, *Callicarpa arborea*, *Castanopsis indica*, *Fraxinus floribunda*, *Macaranga denticulata* etc., Dominant elements of temperate forests are *Alnus nepalensis*, *Acer campbelli*, *Engelhardtia spicata*, *Juglans regia* and spp. from *Quercus*. While the alpine vegetation is dominated by shrubby species of *Rhododendron*, *Berberis*, *Cotoneaster*, *Gaultheria*.

## METHODOLOGY

Ethno-botanical information was collected during the year 1997 - 2002. Both qualitative as well as the quantitative information regarding the use of plants were collected through individual interviews as well as participatory rural appraisal (PRA) method. Open ended and structured interviews were conducted with questionnaire for the collection of data on Local names, uses, Parts used and mode of preparation and administration. During the interviews, free listing of information were made about a particular topic, disease and a specific plants used for. During the PRA study, different groups of people were interviewed independently and each group was allowed to give their own opinion about the herbal remedies. Each group was asked to make a preference ranking of the uses of plant, when a particular plant is being used for different diseases. People were asked to assign mean numerical values to a plant species according to their perceived significance. The details regarding the method of preparations of various doses were discussed elaborately and documented. The plant specimens collected, were later processed, identified (Hara & al., 1978, 1982; Hara & Williams, 1979; Polunin & Stainton, 1984; Grierson & Long, 1983 - 1987) and deposited in the Herbarium, Botanical Survey of India, Sikkim Himalayan Circle, Gangtok (BSHC).

*Enumeration of the medicinal plants and their uses.*

**1. *Abelmoschus manihot* (L.) Medic. (Malvaceae); S.S.Dash 17644, 21164.**

*Local name:* Janglii bhindi.

*Parts used:* Root.

*Therapeutic use(s):* Chronic cold and cough.

*Mode of use and dose:* Root decoction is taken orally with salt to cure sour throat and running nose.

**2. *Abies densa* Griff. (Pinaceae); S.S.Dash 24034, 16210(a).**

*Local name:* Gobresaalla.

*Parts used:* Bark, Cones.

*Therapeutic use(s):* i. Toothache, diuretic; ii. Emmenagogue.

*Mode of use and dose:* i. Bark powder brushed with finger to get rid of toothache. ii. Strong decoction of the cones are taken orally to reduce white discharge after menstruation. This also reduces the bad odour of urine.

**3. *Abroma augusta* L. (Sterculiaceae); S.S.Dash 19718.**

*Local name:* Kapasi.

*Parts used:* Bark and Flowers.

*Therapeutic use(s):* Menstrual disorders.

*Mode of use and dose:* Paste of about 10 gm of bark and 2/3 flowers taken orally to regularize menses.

**4. *Abrus precatorius* L. (Fabaceae); S.S.Dash 10783.**

*Local name:* Lallgeri.

*Parts used:* i. Seed; ii. Leaf.

*Therapeutic use(s):* i. Emmenagogue, abortifacient; ii. Cough and cold.

*Mode of use and dose:* i. About 7/8 seeds are ground into paste and mixed with 100 ml of fresh goat milk. The whole mixture is kept in a wooden vessel and left for 12 hours. The mixture is taken orally in empty stomach to cure menstrual disorders. Concentrated paste taken orally for abortion. ii. Smoke of dried leaves inhaled to clear nasal congestion.

**5. *Achyranthes bidentata* Blume (Amaranthaceae) S.S.Dash 20703.**

*Local name :* not known.

*Parts used:* Whole plant.

*Therapeutic use(s):* Piles, skin eruptions.

*Mode of use and dose:* Fresh plants paste is applied externally to cure pile and to reduce pain. The paste is also applied to cure skin eruptions.

**6. *Aconitum ferox* Wall. ex Ser. (Ranunculaceae); S.S.Dash 27225.**

*Local name:* Bikhuma.

*Parts used:* Root.

*Therapeutic use(s):* Rheumatism.

*Mode of use and dose:* About one gm of root paste is taken orally twice a day for one month to cure rheumatic pains.

**7. Aconitum heterophyllum** Wall. ex Royle (Ranunculaceae); *S.S.Dash* 27227.

*Local name:* Bikh.

*Parts used:* i. Dried root; ii. Rhizome.

*Therapeutic use(s):* i. Blood dysentery, anthelmintic; ii. Epilepsy.

*Mode of use and dose:* About 5gm. of root paste is taken orally to cure blood dysentery and to expel worms. Excess dose proves fatal. ii. Rhizome paste is made into small tablets of 5mg each. One tablet twice a day taken orally to cure mental depression and headache.

**8. Acoros calamus** L. (Acoraceae); *S.S.Dash* 22082.

*Local name:* Bojo.

*Parts used:* Rhizome.

*Therapeutic use(s):* i. Cough and fever; ii. Dysentery.

*Mode of use and dose:* i. Decoction of the root is taken orally to cure cough and fever. ii. A piece of rhizome is chewed to cure dysentery.

**9. Ageratum conyzoides** L. (Asteraceae); *S.S.Dash* 22053.

*Local name:* Ilamey.

*Parts used:* Leaves.

*Therapeutic use(s):* Antiseptic.

*Mode of use and dose:* Fresh leaf paste is applied on cuts and wounds as antiseptic.

**10. Agrimonia pilosa** Ledeb. ( Saxifragaceae); *S.S.Dash* 24354.

*Local name:* Kukrapankha.

*Parts used:* Root.

*Therapeutic use(s):* Gastric disorders, blood dysentery.

*Mode of use and dose:* Root decoction is taken orally to cure gastric disorders. Root paste is taken orally to cure blood dysentery.

**11. Ainsliaea latifolia** (D.Don) Sch.- Bip. (Asteraceae); *S.S.Dash* 24101.

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Stomachache.

*Mode of use and dose:* Root paste after dilution with warm water taken orally for stomachache caused due to indigestion.

**12. Ajuga bracteosa** Wall. ex Benth. (Lamiaceae); *S.S.Dash* 22785.

*Local name:* Ratipa.

*Parts used:* i. Root; ii. Plant paste.

*Therapeutic use(s):* Urinary disorder; ii. Boils, Carbuncles, Purgative.

*Mode of use and dose:* i. Decoction of the root taken orally to cure urinary disorders and burning sensation during urination. ii. Decoction of root is also taken orally to cure hangover caused due to over consumption of liquor. iii. Plant paste is mixed with flour of ragi locally known as Kodu and applied around the boils and carbuncles to facilitate easy burst.

**13. Alangium chinense** (Lour.) Harms. (Alangiaceae), *BSHC* 2168.

*Local name:* Okhne.

*Parts used:* Shoot and root.

*Therapeutic use(s):* Emmenagogue.

*Mode of use and dose:* The tender shoots and roots in equal quantity mixed with 5-7 black pepper and crushed to a paste. Pills of 5 gm each are prepared from the paste and one pill daily for 15 days taken orally to regularize the menses.

**14. Alstonia scholaris** R.Br. (Apocyanaceae) ; *S.S.Dash* 21118.

*Local name:* Chatiwan.

*Parts used:* Shoot.

*Therapeutic use(s):* Galactagogue, (enhances milk flow).

*Mode of use and dose:* About 100 ml of strong decoction of tender shoot is cooled and given orally in empty stomach to new mothers for easy flow of milk.

**15. Amaranthus spinosus** L. (Amaranthaceae) *BSHC* 1657.

*Local name:* Ginegi.

*Parts used:* Root.

*Therapeutic use(s):* Amenorrhoea.

*Mode of use and dose:* i. One teaspoon of the root paste is administered orally to regularize menstrual disorders. ii. The root is cooked with the banana pith and taken orally to alleviate abdominal pains during menstruation.

**16. Ammomum subulatum** Roxb. (Zingiberaceae); *S.S.Dash* 20578.

*Local name:* Bada elachi.

*Parts used:* Fruit.

*Therapeutic use(s):* Cold & cough.

*Mode of use and dose:* About 5 gm of fruits paste is taken orally 4 times a day to cure sour throat and cold.

**17. Anemone rivularis** Buch. Ham. ex DC. (Ranunculaceae); *S.S.Dash* 22752.

*Local name:* Supka.

*Parts used:* Leaf and shoot.

*Therapeutic use(s):* Veterinary use.

*Mode of use and dose:* The paste of above ground part is applied externally on yaks to get relief from flies and other insects.

**18. Anaphalis contorta** Hook.f. (Asteraceae); *S.S.Dash* 24009.

*Local name:* Not known.

*Parts used:* Flower.

*Therapeutic use(s):* Styptic.

*Mode of use and dose:* Flower paste is applied on bleeding wounds as an antiseptic.

**19. Aphanamixis polystachya** (Wall.) Parker (Meliaceae); *S.S.Dash* 22090.

*Local name:* Lahasune.

*Parts used:* i. Seed; ii. Bark.

*Therapeutic use(s):* i. Anthelmintic; ii. Abdominal pain before delivery, health tonic.

*Mode of use and dose:* i. Seed paste is given orally to children to cure stomachache and expelling intestinal worms. ii. Decoction of the bark is given orally to get relief from abdominal pain and stretching pain after delivery. Two teaspoons of the decoction is mixed with mild and taken orally as a health tonic after delivery.

**20. *Artemisia nilagirica* (C.B.Clarke) Pamp. (Asteraceae); S.S.Dash 22852.**

*Local name:* Titeypati.

*Parts used:* i. Leaves; ii. Leafy inflorescence.

*Therapeutic use(s):* i. Vermifuge for children; ii. Antiseptic; iii. Nose bleeding.

*Mode of use and dose:* i. Leave paste is diluted with water and given orally in the evening to expel intestinal worm. ii. Two to three teaspoons of thick decoction of leafy inflorescence given orally to cure fever. iii. Leaves are crushed in hands and inserted in the nasal cavity to stop nose bleeding due to altitudinal effect. The juice of the leaf also used as an antiseptic in external cuts and wounds.

**21. *Astilbe rivularis* D.Don (Saxifragaceae) S.S.Dash 20926, 24135.**

*Local name:* Boro okhati.

*Parts used:* i. Rhizome; ii. Stem + Root.

*Therapeutic use(s):* i. Gynecological disorders; ii. Body ache.

*Mode of use and dose:* i. Decoction of the rhizome is given orally to cure bad odour discharges during menses. ii. The decoction of the stem and root is given orally or mixed with the bathing water to cure general body ache. This dose is given to new mothers particularly.

**22. *Begonia cathcartii* Hook.f. & Thomson (Begoniaceae); S.S.Dash 20712.**

*Local name:* Not known.

*Parts used:* Whole plant.

*Therapeutic use(s):* Febrifuge.

*Mode of use and dose:* Two teaspoon of the plant paste mixed with warm milk and taken orally to reduce body temperature and to cure fever.

**23. *Belamcanda chinensis* DC. (Iridaceae); S.S. Dash 18775.**

*Local name:* Tarwarphula Root.

*Parts used:* Root.

*Therapeutic use(s):* Constipation.

*Mode of use and dose:* Raw roots are chewed in the evening to cure constipation.

**24. *Berberis aristata* DC. (Berberidaceae); S.S.Dash 27008.**

*Local name:* Not known.

*Parts used:* Root and bark.

*Therapeutic use(s):* Conjunctivitis.

*Mode of use and dose:* The juice of the root and bark is mixed in equal proportion and applied externally on eyes for 15 minutes to cure conjunctives. Eyes should be washed properly after 15 minutes.

**25. *Berberis wallichiana* DC. (Berberiaceae); S.S.Dash 22776.**

*Local name:* Chitrokanra.



*Parts used:* Fruits.

*Therapeutic use(s):* Dog bite, antidotes.

*Mode of use and dose:* Fruit paste is given orally in case of dog bite and also applied externally on affected parts to neutralize the toxic effect.

**26. *Bergenia purpurascens*** (Hook. f. & Thomson) Engl. (Saxifragaceae); *S.S.Dash* 27221.

*Local name:* Pakhan bet.

*Parts used:* Root.

*Therapeutic use(s):* Stomachache, pneumonia and inflammation in tonsil.

*Mode of use and dose:* i. Small piece of the root is crushed and the juice is taken orally to cure stomachache. The paste of the root is taken orally to cure pneumonia. ii. The decoction of the root is gargled to cure inflammation in tonsils and throat infections.

**27. *Berginia ciliata*** (Haworth) Sternb. (Saxifragaceae); *BSHC* 5380.

*Local name:* Pakhanbet.

*Parts used:* i. Rhizome; ii. Whole plant.

*Therapeutic use(s):* i. Diarrhoea and vomiting; ii. Leucorrhoea.

*Mode of use and dose:* i. Fresh root paste mixed with warm water and given orally to check diarrhoea and vomiting. ii. About 10 gm of the plant paste is given orally to check white discharge.

**28. *Betula alnoides*** Buch.-Ham. (Betulaceae); *S.S.Dash* 24019.

*Local name:* Sour.

*Parts used:* i. Bark paste; ii. Stem bark.

*Therapeutic use(s):* i. Body ache and sprain; ii. Liver disorder, antiseptic.

*Mode of use and dose:* i. Bark paste is applied externally to alleviate pain. ii. About 30 ml of the bark decoction is taken orally in empty stomach to cure bile related ailments and acidity.

**29. *Betula utilis*** D. Don (Betulaceae); *S.S.Dash* 22751.

*Local name:* Bhojpata.

*Parts used:* Bark.

*Therapeutic use(s):* Bronchitis.

*Mode of use and dose:* 10 ml of bark juice is taken orally to cure bronchitis and cough.

**30. *Bidens pilosa*** L. (Asteraceae); *S.S.Dash* 22051.

*Local name:* Kuro.

*Parts used:* Leaves.

*Therapeutic use(s):* i. Herbal bath for body ache; ii. Earache.

*Mode of use and dose:* i. Fresh leaf of the plant is kept in hot water for one hour, then the warm water is used for bathing to cure general bodyache. ii. Four to five drops of the fresh leaf juice is dropped in each ear to cure earache and pus in the ear.

**31. *Bischofia javanica*** Blume (Nyssaceae); *S.S.Dash* 18774.

*Local name:* Kainjal.

*Parts used:* Bark, Seed.

*Therapeutic use(s)*: Muscular pain and inflammation.

*Mode of use and dose*: Paste of bark and seeds (mixed in 1:2) is applied externally to cure muscular pain and inflammation.

**32. Bistorta affinis** (D. Don) Green (Polygonaceae); *S.S.Dash* 27292.

*Local name*: Not known.

*Parts used*: Root.

*Therapeutic use(s)*: i. Anodyne; ii. Astringent.

*Mode of use and dose*: i. Root paste is applied externally around the affected areas to get relief from pain and to reduce inflammations. ii. Root paste applied on external injuries to stop bleeding.

**33. Bistorta vivipara** (L.) Gray (Polygonaceae); *S.S.Dash* 22719.

*Local name*: Not known.

*Parts used*: Root.

*Therapeutic use(s)*: i. Astringent; ii. Sore throat and cold.

*Mode of use and dose*: i. Root paste is applied externally to stop bleeding. ii. Decoction of the root is gargled to cure sore throat and cold.

**34. Boenninghausenia albiflora** (Hook.)Reichb. (Rutaceae); *S.S.Dash* 20729.

*Local name*: Yerma shing.

*Parts used*: Leaves.

*Therapeutic use(s)*: Anti-inflammatory.

*Mode of use and dose*: Leaf paste is applied around the inflammatory part to get a quick relief from pain and swelling.

**35. Bombax ceiba** L. (Bombacaceae); *BSHC* 8515.

*Local name*: Simal.

*Parts used*: Bark, Root bark.

*Therapeutic use(s)*: i. Diuretic; ii. Emmenagogue.

*Mode of use and dose*: i. Decoction of the bark is taken orally daily for 7 days to cure burning sensation during urination. ii. The bark of the root is crushed into paste with garlic and taken orally twice a day for 7 days to regularize menses.

**36. Brugmasia suaveolens** Bercht & Presl (Solanaceae); *S.S.Dash* 18878.

*Local name*: Dhokrey Phul.

*Parts used*: Leaves.

*Therapeutic use(s)*: Cough & Cold.

*Mode of use and dose*: Leaf paste is tied in a clean cloth and squeezed in nasal cavity to clear nasal congestion and sinusitis.

**37. Buddleja asiatica** Lour. (Buddlejaceae); *S.S.Dash* 23813.

*Local name*: Sanapati.

*Parts used*: Leaf.

*Therapeutic use(s)*: Headache, fore head pain.

*Mode of use and dose*: Leaf paste is applied externally on fore head to cure headache.

**38. Butea monosperma** (Lam.) Taub.(Leguminosae-Papilionoideae)

*Local name:* Palase, Mauwa.

*Parts used:* i. Stem bark + Leaf, Seed.

*Therapeutic use(s):* i. Contraceptive; ii. Amenorrhoea.

*Mode of use and dose:* i. Stem bark along with the tender leaves crushed into paste. The paste is fried with butter. One tea spoon of the paste is taken orally daily in the evening as contraceptive.

ii. One teaspoon of seed paste diluted in cow milk and taken orally daily in the evening as contraceptive. Bark One teaspoon of bark paste is diluted in milk and taken orally to regularize menses.

**39. Caesalpinia bonduc** Roxb. (Leguminosae subfam. Caesalpinioideae);

*Local name:* Nicker Ruk.

*Parts used:* Seed.

*Therapeutic use(s):* Emmenagogue and Amenorrhoea.

*Mode of use and dose:* About 50 gm of seeds are ground with about 40 gm. dried roots of *Brassica juncea* L. and a paste is made out of this. One teaspoon of the paste is taken orally twice a day to regularize menses.

**40. Callicarpa arborea** Roxb. (Verbenaceae); BSHC 11343.

*Local name:* Guenyhlo.

*Parts used:* Bark.

*Therapeutic use(s):* Gastric trouble.

*Mode of use and dose:* Fresh bark is kept in water for one night and the water is taken orally to cure gastric troubles.

**41. Caltha palustris** L. (Ranunculaceae); S.S.Dash 22721.

*Local name:* Not known.

*Parts used:* Whole plant.

*Therapeutic use(s):* Rheumatic pains.

*Mode of use and dose:* Plant paste is applied externally on affected parts to get relief from pain and swelling.

**42. Campylandra aurantiaca** Baker (Zingiberaceae); S.K. Rai 3629.

*Local name:* Nakima.

*Parts used:* Flowers.

*Therapeutic use(s):* Body ache after delivery.

*Mode of use and dose:* Fresh flowers of the plant is kept in hot water for one hour, then the warm water is used for bathing to cure general bodyache as a post delivery measure.

**43. Cannabis sativa** L. (Cannabinaceae); S.S.Dash 13781.

*Local name:* Ganja.

*Parts used:* Inflorescence.

*Therapeutic use(s):* Stomachache due to indigestion.

*Mode of use and dose:* 10 gm of the paste of the inflorescence is taken orally to cure stomachache due to indigestion.

**44. Capsella bursa-pastoris** (L.) Moench (Brassicaceae); *S.S.Dash* 18074.

*Local name:* Shepherds purse (E).

*Parts used:* Whole plant.

*Therapeutic use(s):* Hemorrhage, veterinary.

*Mode of use and dose:* Plant paste applied externally to stop bleeding in cattle and other domestic animals.

**45. Cassia fistula** L. (Caesalpinaceae); *S.K.Rai* 11901.

*Local name:* Raj Birse, Sunala.

*Parts used:* Root.

*Therapeutic use(s):* Rheumatism.

*Mode of use and dose:* Decoction of the root is taken orally to cure inflammation due to rheumatism.

**46. Centella asiatica** (L.) Urban (Apiaceae); *S.S.Dash* 20705.

*Local name:* Golpata.

*Parts used:* i. Aerial parts; ii. Flowers.

*Therapeutic use(s):* i. Hypertension; ii. Antiseptic.

*Mode of use and dose:* i. Stem of the plant is chewed for half an hour to cure hypertension. ii. Flower paste is applied around wounds of cattle to speedy recovery.

**47. Cinnamomum tamala** Nees (Lauraceae); *S.S.Dash* 19297.

*Local name:* Tejpata.

*Parts used:* Bark.

*Therapeutic use(s):* Diarrhoea.

*Mode of use and dose:* Equal amount of the bark and the tender leaves of *Psidium juajava* is mixed and made in to a paste. About 10 mg of paste is taken orally to cure diarrhoea.

**48. Circaea alpina** L. (Onagraceae); *S.S.Dash* 25436.

*Local name:* Not known.

*Parts used:* Whole plant.

*Therapeutic use(s):* Antiseptic; Styptic.

*Mode of use and dose:* Plant paste is applied externally on bleeding wounds for stop bleeding and rapid recovery.

**49. Cissampelos pareira** L. (Menispermaceae); *S.S.Dash* 21492.

*Local name:* Tamarkey.

*Parts used:* Stem.

*Therapeutic use(s):* Stomachache, liver disorder.

*Mode of use and dose:* Small piece of the stem is chewed for half an hour to cure stomachache due to excessive bile. This also checks vomiting tendency due to acidity.

**50. Clematis buchananiana** DC. (Ranunculaceae); *S.S.Dash* 20786.

*Local name:* Pinasi lahar.

*Parts used:* i. Root; ii. Plant decoction.

*Therapeutic use(s)*: i. Nasal congestion, sinusitis; ii. Eczema and fungal infections.

*Mode of use and dose*: i. Small piece of the root is crushed and inhaled in every half an hour interval to clear nasal congestion and sinusitis. ii. Hot plant decoction of the plant is used to wash regularly the affected areas to cure eczema and other fungal infections.

**51. Clematis wightiana** Wall. (Ranunculaceae); *S.S.Dash* 22701.

*Local name*: Pinesey lahara.

*Parts used*: i. Root; ii. Bark + Leaf.

*Therapeutic use(s)*: i. Indigestion; ii. Nasal congestion and sinusitis.

*Mode of use and dose*: i. About 5 ml of root decoction is taken orally in every half an hour to cure indigestion and flatulent. ii. Equal amount of the stem bark and leaf is crushed and tied in a clean cloth. The cloth is squeezed and one to two drops of the juice sap is dropped in the nasal cavity to cure nasal congestion and sinusitis.

**52. Cleome viscosa** L. (Capparaceae); *BSHC* 23456.

*Local name*: Harhare.

*Parts used*: Tender shoot.

*Therapeutic use(s)*: Galactagogue.

*Mode of use and dose*: bout 250 gm of tender shoots are boiled to make a strong decoction. 2-3 teaspoon of this decoction is given orally for 3-4 times a day to breast feeding mothers for better lactation.

**53. Clerodendrum infortunatum** Gaertn. (Verbenaceae); *S.S.Dash* 22047.

*Local name*: Chitu Banker.

*Parts used*: Root.

*Therapeutic use(s)*: Abdominal pain during mense.

*Mode of use and dose*: One teaspoon of root paste is taken orally to alleviate acute abdominal pain during menstruation. The prescription is very much effective for teen aged girls.

**54. Clinopodium umbosum** (Bieb.) Koch. (Lamiaceae); *S.S.Dash* 22804.

*Local name*: Not known.

*Parts used*: Leaves.

*Therapeutic use(s)*: Antiseptic.

*Mode of use and dose*: Leaf juice is applied externally as antiseptic.

**55. Coelogyne fuscescens** Lendley (Orchidaceae); *S.S.Dash* 22038.

*Local name*: Sunakhadi.

*Parts used*: Pseudo bulb.

*Therapeutic use(s)*: Stomach ailment.

*Mode of use and dose*: Five to six pseudo bulbs are grounded in to paste and spread over a clean cloth and dried in sun. The cakes like things are chewed to cure stomach ailments.

**56. Coix lachryma-jobi** L. (Poaceae); *S.S.Dash* 20939.

*Local name*: Not known.

*Parts used*: Root.

*Therapeutic use(s)*: Urinary disorder.

*Mode of use and dose:* About 50 gm. of the root is boiled in 5lts of water to make a decoction. About 50 ml of the decoction is taken orally twice a day for 7 days to cure urinary infections and burning sensation during urination.

**57. Colebrookea oppositifolia** Sm. (Lamiaceae); *BSHC* 15316.

*Local name:* Dhusro.

*Parts used:* Leaves.

*Therapeutic use(s):* Antiseptic.

*Mode of use and dose:* Leaf paste is applied externally as antiseptic.

**58. Commelina benghalensis** L. (Commelinaceae); *N.R Mandal* 11901.

*Local name:* Kanijhar.

*Parts used:* Leaf.

*Therapeutic use(s):* Antiseptic.

*Mode of use and dose:* Leaf paste is applied externally as antiseptic.

**59. Costus speciosus** (Koenig) Sm. (Costaceae); *BSHC* 15801.

*Local name:* Betlauri.

*Parts used:* Rhizome.

*Therapeutic use(s):* i. Breast swelling; ii. Health Tonic.

*Mode of use and dose:* i. About 25 gm of rhizome is grounded to paste and cooked. Warm paste of the rhizome is given orally after delivery to reduce pain in breast and for easy flow of milk. ii. One teaspoon of sun dried root powders is mixed with Rum or *chaang* (local beer) and given orally as a health tonic after delivery.

**60. Croton caudatus** Geiseler (Euphorbiaceae); *BSHC* 7177.

*Local name:* Holonre.

*Parts used:* Bark.

*Therapeutic use(s):* Contraceptive.

*Mode of use and dose:* Stem bark is crushed with equal amount of *Curcuma longa* L. and *Piper longum* L. and made into a paste. One teaspoon of paste is taken orally daily in the evening as contraceptive.

**61. Cuscuta reflexa** Roxb. (Cuscutaceae); *S.S.Dash* 22097.

*Local name:* Binajharhi.

*Parts used:* i. Whole plants; ii. Stem.

*Therapeutic use(s):* i. Anodyne; ii. Leucorrhoea.

*Mode of use and dose:* i. Stem paste is applied externally around the swollen parts to get relief from pain. ii. Equal amount of stem and leaves of *Cerastium* spp. is crushed in to a paste. About 10 gm of the paste is taken orally twice a day for 15 days to cure white discharge in urine.

**62. Cyathea spinulosa** Wall. ex Hook. (Cyatheaceae); *BSHC* 5182.

*Local name:* Not known.

*Parts used:* Leaf pith.

*Therapeutic use(s):* Anodyne.

*Mode of use and dose:* The paste of the leaf pith applied externally to get relief from pain and inflammation.

**63. *Dactylorhiza hatagirea* (D. Don) Soo (Orchidaceae); BSHC 22936.**

*Local name:* Panchaule.

*Parts used :* Root, tuber.

*Therapeutic use(s):* Aphrodisiac.

*Mode of use and dose:* 5 gm of root/ tuber paste is taken orally daily in the evening as an enhancer of sexual stamina.

**64. *Dalbergia latifolia* Roxb. (Fabaceae); S.S.Dash 14392.**

*Local name:* Satisal.

*Parts used:* Bark.

*Therapeutic use(s):* Ovulation and Sexual potency.

*Mode of use and dose:* About 10 gm of the dried bark paste is taken orally twice a day for one month to increase sexual potency and for good ovulation.

**65. *Daphne bholua* Buch.-Ham. ex D. Don (Thymeliaceae); S.S.Dash 20710.**

*Local name:* Kagatey.

*Parts used:* Leaves and Seed.

*Therapeutic use(s):* Urinary disorders.

*Mode of use and dose:* Decoction of the leaf and seeds is mixed in equal proportion and taken orally to cure bad odor in urine and other urinary infection.

**66. *Datura metel* L. (Solanaceae); S.K.Rai 13780.**

*Local name:* Dhatura.

*Parts used:* Seed.

*Therapeutic use(s):* Against mad dog bite.

*Mode of use and dose:* Seed paste is given orally against mad dog bite. Precautions are to be taken during preparation of the doses as higher dose may cause insane.

**67. *Dendrocalamus hamiltonii* Nees & Arn. (Poaceae); BSHC 697.**

*Local name:* Tamaa.

*Parts used:* Leaves.

*Therapeutic use(s):* Menstrual disorder.

*Mode of use and dose:* Tender leaves are crushed with seeds of *Hibiscus cannabinus* L. (Nep. Posto) and made in to a paste. The paste is given orally twice or thrice a day to reduce the excessive bleeding during menstrual cycle.

**68. *Desmodium elegans* DC. (Fabaceae); B.Mitra 6855.**

*Local name:* Sarkinu.

*Parts used:* i. Root; ii. Fruit.

*Therapeutic use(s):* i. Expectorant; ii. Diuretic.

*Mode of use and dose:* i. Warm root decoction is gargled and taken orally to cure cough and also acts as an expectorant. ii. About 50 ml of the fruit decoction is taken orally in every 15 minutes to promote discharge of urine.

**69. Dichroa febrifuga** Lour. (Hydrangiaceae); *S.S.Dash* 20755.

*Local name:* Nilgeri, Basak.

*Parts used:* Leaves.

*Therapeutic use(s):* Febrifuge, Bodyache.

*Mode of use and dose:* Root paste is administered twice a day to cure fever and to get relief from the body pain.

**70. Dichrocephala integrifolia** (L.f.) O. Kuntze (Asteraceae); *S.S.Dash* 22069.

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Astringent.

*Mode of use and dose:* Leaf paste is applied externally around fresh wounds to stop bleeding.

**71. Didymocarpus pedicellata** R. Br. (Gesneriaceae); *S.S.Dash* 20732.

*Local name:* Not known.

*Parts used:* Leaves.

*Mode of use and dose:* Antiseptic.

*Mode of use and dose:* Leaf paste is applied in cuts and wounds as antiseptic.

**72. Dioscorea belophylla** Viogl. ex Haines (Dioscoriaceae); *S.S.Dash* 22069.

*Local name:* Panu tarul, Githa tarul.

*Parts used:* Tubers.

*Therapeutic use(s):* Anodyne, anti inflammatory.

*Mode of use and dose:* Tuber paste is applied around the affected part to get relief from pain and inflammation.

**73. Drymaria cordata** Willd. (Caryophyllaceae); *S.S.Dash* 20758.

*Local name:* Abhijhal.

*Parts used:* Plant.

*Therapeutic use(s):* Viral fever, Sinusitis.

*Mode of use and dose:* out 10 gm of plant paste taken orally daily to cure chronic cough and cold. Plant paste is tied in a cloth, one or two drops of juice is squeezed in nasal cavity to cure sinusitis.

**74. Elephantopus scaber** L. (Asteraceae); *BSHC* 1137.

*Local name:* Godhi (H).

*Parts used:* Root.

*Therapeutic use(s):* Abdominal pain before and during delivery.

*Mode of use and dose:* Fresh root are made into fine paste and applied externally on lower abdomen during labour pain to facilitate easy delivery. This use also reduces prolonged labour pain.

**75. Ephedra gerardiniana** Wall. (Gnetaceae); *BSHC* 6013.

*Local name:* Tseing.

*Parts used:* Stem.

*Therapeutic use(s):* Bronchitis, respiratory problems.



*Mode of use and dose:* 5 ml of the stem juice is taken orally twice a day to cure bronchitis and other respiratory problems.

**76. Equisetum diffusum** D. Don (Equisetaceae); BSHC 32272.

*Local name:* Kurkure.

*Parts used:* Whole plant.

*Therapeutic use(s):* Skin rashes.

*Mode of use and dose:* The plant paste is applied externally around the affected parts to cure the skin rashes and other skin irritations.

**77. Erythrina arborescens** Roxb. (Fabaceae); S.S.Dash 22095.

*Local name:* Not known.

*Parts used:* Seed.

*Therapeutic use(s):* Rheumatic pains.

*Mode of use and dose:* Seed paste is applied around affected areas to reduce pain and inflammation.

**78. Eupatorium adenophorum** Spreng. (Asteraceae); S.S.Dash 18878.

*Local name:* Banmara.

*Parts used:* Leaf juice.

*Therapeutic use(s):* Swelling, Inflammation, Antiseptic.

*Mode of use and dose:* Leaf juice is mixed with the latex of any *Ficus* sp. and applied externally to cure swelling and inflammation of bones. The also acts as an antiseptic.

**79. Eupatorium cannabinum** L. ( Asteraceae ) ; S.S.Dash 24879.

*Local name:* Kalijhar, banmara.

*Parts used:* Leaves.

*Therapeutic use(s):* Styptic (Blood coagulate).

*Mode of use and dose:* Leaf paste applied on bleeding wounds to stop bleeding immediately.

**80. Eurya acuminata** DC. (Theaceae); S.S.Dash 20713.

*Local name:* Not known.

*Parts used:* i. Seed ii. Leaf paste.

*Therapeutic use(s):* i. Rheumatic pain; ii. Insect antidote.

*Mode of use and dose:* i. Fruit paste is applied around the affected parts to get relief from pain due to rheumatic. ii. Leaf paste is applied around the affected area and taken orally in case of insect biting. This application decreases the burning sensation.

**81. Euphorbia hirta** L. (Euphorbiaceae) BSHC 13349.

*Local name:* Dudhi.

*Parts used:* Whole plant.

*Therapeutic use(s):* Galactagogue.

*Mode of use and dose:* The whole plant along with the roots are washed carefully and grounded into paste. The paste is applied externally on and around breast for easy flow of milk and better lactation. The also reduce pain in the breast.

**82. Ficus semicordata** Buch.-Ham ex J.E..Smith (Moraceae); *S.S.Dash* 21466.

*Local name:* Rai khaniu.

*Parts used:* Bark.

*Therapeutic use(s):* Purgative.

*Mode of use and dose:* Bark paste is applied externally around boils and carbuncles for easy burst and reduce pain.

**83. Floscopa scandens** Lour (Commelinaceae); *S.S.Dash* 19231.

*Local name:* Kanejhar.

*Parts used:* Inflorescence.

*Therapeutic use(s):* Eye and ear drops.

*Mode of use and dose:* The inflorescence is crushed and wrapped in a wet cloth. Two to three drops of the juice is poured in ears to cure fungal infection and pain.

**84. Fraxinus floribunda** Wall. (Oleaceae); *BSHC* 17994.

*Local name:* Lnakoore.

*Parts used:* Bark.

*Therapeutic use(s):* Laxative.

*Mode of use and dose:* Bark decoction is taken orally in night to cure constipation.

**85. Galinsoga parviflora** Cav. (Asteraceae) ; *S.S.Dash* 20706.

*Local name:* Udase.

*Parts used:* Whole plant.

*Therapeutic use(s):* Antidote for insect bite.

*Mode of use and dose:* The plant is crushed and rubbed in the affected area to reduce burning sensation due to insect bite.

**86. Gaultheria nummularioides** D. Don ( Ericaceae); *S.S.Dash* 24045

*Local name:* Shokpa.

*Parts used:* Leaves.

*Therapeutic use(s):* Laxative.

*Mode of use and dose:* About 100 ml of the leaf decoction is taken orally in night to cure constipation.

**87. Girardinia diversiflora** (Link.) Friis (Urticaceae).

*Local name:* Bhangresishnu.

*Parts used:* i. Whole plant; ii. Root paste.

*Therapeutic use(s):* i. Bronchitis, Tuberculosis; ii. To burst boils.

*Mode of use and dose:* i. Hot decoction of the whole plant is taken orally to cure bronchitis and also believed to cure tuberculosis. ii. Root paste is applied around the boils for easy burst and also to recover rapidly.

**88. Gloriosa superba** L. (Colchiaceae); *S.S.Dash* 20456.

*Local name:* Not known.

*Parts used:* Tuber.

*Therapeutic use(s):* i. Leucorrhoea; ii. Reduce pain and bleeding after delivery.

*Mode of use and dose:* One tea spoon of tuber paste is diluted in milk and given orally for seven days to regularize the menstrual cycle and to reduce excessive abnormal mucus discharge. ii. The tuber paste is applied externally on lower abdomens during labor pain to facilitate easy delivery and also easy release of placenta. This application after delivery reduces bleeding and pain due to stretching.

**89. Gmelina arborea** Roxb. (Verbenaceae); *S.S.Dash* 22341.

*Local name:* Khamari.

*Parts used:* i. Leaves; ii. Bark.

*Therapeutic use(s):* i. Febrifuge; ii. Demulcent, Scabies.

*Mode of use and dose:* Leaves decoction is taken orally to cure fever. ii. Bark paste is applied through out the body to cure scabies and irritation.

**90. Gynocardia odorata** R. Br. (Flacourtiaceae).

*Local name:* Badre phal.

*Parts used:* Seed.

*Therapeutic use(s):* Epilepsy.

*Mode of use and dose:* Seed paste is applied on the forehead to cure headache and epilepsy.

**91. Hedera nepalensis** Koch (Hydrangiaceae); *S.S.Dash* 20789.

*Local name:* Not known.

*Parts used:* i. Stems; ii. Leaves + Fruit.

*Therapeutic use(s):* i. Anthelmintic; ii. Stimulants.

*Mode of use and dose:* i. Stem bark is crushed into paste and about 5 gm. of paste taken orally with warm water expelling worms. ii. Equal amount of leaves and fruit paste mixed and taken orally as a sexual stimulant for women.

**92. Hedyotis scandens** Roxb. (Rubiaceae); *S.S.Dash* 20745.

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Anodyne, anti-inflammatory.

*Mode of use and dose:* About 50 gm. of root bark is crushed into a paste and applied around the affected area reduce inflammation due to sprain. This application also reduces pain.

**93. Hedychium spicatum** Ham. ex Smith (Zingiberaceae).

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Stomach disorder and dysentery.

*Mode of use and dose:* Root paste is taken orally to cure dysentery due to indigestion. The dose also cures other stomach disorder.

**94. Hemiphragma heterophyllum** Wall. (Scrophulariaceae); *S.S.Dash* 24046.

*Local name:* Malajhar.

*Parts used:* Whole plant.

*Therapeutic use(s):* Pharyngitis and Inflammation of tonsils.

*Mode of use and dose:* Warm decoction of the plant is gargled to cure pharyngitis and inflammation of tonsils.

**95. Heracleum wallichii** DC. (Apiaceae); *S.S.Dash* 18427.

*Local name:* Chimpling.

*Parts used:* i. Fruits; ii. Root.

*Therapeutic use(s):* i. Cough and cold; ii. Body ache.

*Mode of use and dose:* i. Fruit paste is taken orally to cure cough and cold due to viral fever. ii. Root decoction is mixed with one bucket of water and used for bathing to cure general body pain.

**96. Hippophae salicifolia** D. Don (Elaeagnaceae); *S.S.Dash* 18954.

*Local name:* Not known.

*Parts used:* Fruits.

*Therapeutic use(s):* Throat and Tongue infection.

*Mode of use and dose:* Ripen fruit is chewed in mouth to cure throat and tongue infection.

**97. Houttuynia cordata** Thounb. (Saururaceae); *S.S.Dash* 20765.

*Local name:* Gandhejarh.

*Parts used:* i. Leaves; ii. Root.

*Therapeutic use(s):* i. Laxative; ii. Stomach disorders.

*Mode of use and dose:* i. Leaf paste taken orally to cure chronic constipation. ii. One tea spoon of the root paste is mixed with one glass of water and taken orally in the morning to flatulent.

**98. Ilex diphylla** Wall. (Aquifoliaceae); *BSHC* 25090.

*Local name:* Lisha.

*Parts used:* Leaves.

*Therapeutic use(s):* Diuretic.

*Mode of use and dose:* Leaf paste is taken orally to cure foul smell in urine and also to cure painful urination.

**99. Iris clarkii** Hook. f. & Thomson (Iridaceae); *S.S.Dash* 20173.

*Local name:* Cema.

*Parts used:* Dried bulb.

*Therapeutic use(s):* Purgative.

*Mode of use and dose:* The dried bulb is grounded to a fine paste and applied around the external ulcer and carbuncle for rapid recovery.

**100. Juglans regia** L. (Juglandaceae); *S.S.Dash* 22702.

*Local name:* Okhar.

*Parts used:* Fruit coat.

*Therapeutic use(s):* Eczema.

*Mode of use and dose:* Paste of the fruit coat is applied externally around affected parts to cure eczema other skin ailments.

**101. Juniperus recurva** Buch.-Ham. (Cupressaceae); *S.S.Dash* 24004, 22769.

*Local name:* Dhupi.

*Parts used:* i. Fruits; ii. Root.

*Therapeutic use(s)*: i. Stomach disorders; ii. Skin eruption.

*Mode of use and dose*: i. Fruit is boiled for an hour and kept for a night. The decoction is taken orally next morning to cure stomach disorders. ii. Root paste is applied externally to cure skin eruption during winter.

**102. *Laportea terminalis*** Wight (Urticaceae ); *S.S.Dash* 22818.

*Local name*: Patley sisnu.

*Parts used*: Leaves.

*Therapeutic use(s)*: Diuretic.

*Mode of use and dose*: About 5 gm of the plant paste is diluted in 100 ml of water and taken orally to cure urinary problem.

**103. *Litsea cubela*** Pers. (Lauraceae); *S.S.Dash* 22874.

*Local name*: Siltimmur.

*Parts used*: Fruits.

*Therapeutic use(s)*: Stomachache.

*Mode of use and dose*: Fruit decoction is taken orally to cure stomachache due to indigestion.

**104. *Lyonia ovalifolia*** (Wall.) Drude (Ericaceae); *S.S.Dash* 22086.

*Local name*: Angeri.

*Parts used*: Shoots paste.

*Therapeutic use(s)*: Scabies and Skin disorders.

*Mode of use and dose*: Leaf paste of before night is applied in the morning to cure skin diseases particularly itching sensation in the epidermal area.

**105. *Maesa chisia*** D. Don (Myrsinaceae); *S.S.Dash* 20710.

*Local name*: Bilaune.

*Parts used*: Fruits.

*Therapeutic use(s)*: Veterinary.

*Mode of use and dose*: Equal amount of leaf and bark paste mixed and applied all over the body of domestic animals for relief from insects, worm and leech.

**106. *Mahonia nepalensis*** DC. (Berberidaceae); *BSHC* 28224.

*Local name*: Chitray.

*Parts used*: Fruits.

*Therapeutic use(s)*: Diuretic, Urinary disorder.

*Mode of use and dose*: Fruit paste is diluted with water and taken orally to cure bad odour discharges and burning sensation during urination.

**107. *Mallotus philippensis*** DC. (Euphorbiaceae); *BSHC* 18055.

*Local name*: Sundare.

*Parts used*: Glandular hairs of fruits.

*Therapeutic use(s)*: Vermifuge.

*Mode of use and dose*: The glandular hairs of the fruits are kept in water for an hour and taken orally twice a day for 7 days to expel worms from intestine

**108. *Michelia doltsopa* L. (Magnoliaceae); S.S.Dash 14930.**

*Local name:* Rani champ.

*Parts used:* Seed + Bark.

*Therapeutic use(s):* Contraceptive.

*Mode of use and dose:* 30 gm of seed and bark in equal amount mixed and grounded to paste. One to two teaspoon of the paste is taken orally in the evening as contraceptive.

**109. *Murraya koenigii* (L.) Spreng. (Rutaceae); BSHC 365.**

*Local name:* Curry pata.

*Parts used:* Leaf + Root.

*Therapeutic use(s):* Rheumatism, body ache.

*Mode of use and dose:* Equal amount of root and leaf is mixed and grounded to a paste. The paste is applied externally on affected parts to cure rheumatism and body ache.

**110. *Nardostachys grandiflora* DC. (Valerianaceae); BSHC 8880.**

*Local name:* Jatamansi.

*Parts used:* Root.

*Therapeutic use(s):* Spasmodic pain and hysteria.

*Mode of use and dose:* About 5 ml of root paste is diluted water and given orally to cure spasmodic pain.

**111. *Nasturtium officinale* R. Br. (Brassicaceae); S.S.Dash 22002.**

*Local name:* Simbrya.

*Parts used:* Whole Plant.

*Therapeutic use(s):* Cough.

*Mode of use and dose:* Plant decoction is taken orally to cure cough. This dose also acts as an expectorant.

**112. *Ophiorrhiza treutleri* Hook. f. (Rubiaceae); S.S.Dash 20791.**

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Diuretic, Strangury.

*Mode of use and dose:* Leaf paste is diluted with water and taken orally thrice a day to cure burning sensation in urine.

**113. *Oroxylum indicum* Vent. (Bignoniaceae); S.S.Dash 14442.**

*Local name:* Totala.

*Parts used:* i. Bark + Seed; ii. Seed; iii. Root.

*Therapeutic use(s):* i. Contraceptive; ii. Amenorrhoea.

*Mode of use and dose:* i. Sun dried seeds and fruit cover is kept in water for one night. The mixer is then crushed with fresh bark of the plants to a paste, The paste is taken orally twice a day as contraceptive. ii. The seed are grounded with gur and taken orally to regularize mense. iii. Root of the plant and flowers of *Michelia champaca* L. are grounded into paste. One teaspoon of the paste is given orally in empty stomach to newly wedded women as a safe guard against miscarriage.

**114. Osbeckia nepalensis** Hook. (Melastomataceae); *S.S.Dash* 17269.

*Local name:* Not known.

*Parts used:* Flowers.

*Therapeutic use(s):* Astringent.

*Mode of use and dose:* Flower paste is taken orally and applied on wounds for rapid recovery.

**115. Oxalis corniculata** L. (Oxalidaceae); *S.S.Dash* 17042.

*Local name:* Amrul.

*Parts used:* Root + Leave.

*Therapeutic use(s):* Galactagogue.

*Mode of use and dose:* Equal amount of fresh root and leaves are grounded with 5-7 black pepper and make in a paste. One teaspoon of the paste is diluted in one glass of milk and given orally after delivery as a health tonic and for easy flow of milk.

**116. Panax pseudoginseng** Wall. (Araliaceae); *S.S.Dash* 14064.

*Local name:* Ginseng.

*Parts used:* Root.

*Therapeutic use(s):* Aphrodisiac.

*Mode of use and dose:* Root paste is diluted with milk and taken orally to increase sexually potency and vigor.

**117. Bistorta amplexicaulis** Green (Polygonaceae); *S.S.Dash* 28992, 24002.

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Blood dysentery.

*Mode of use and dose:* Root paste is given orally to stop blood dysentery.

**118. Persicaria hydropiper** (L.) Spach. (Polygonaceae); *S.S.Dash* 22066.

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Emmenagogue.

*Mode of use and dose:* Leaf paste taken orally to regularize menses.

**119. Phytolacca acinosa** Roxb. (Phytolaccaceae); *P. Chakraborty* 387.

*Local name:* Jaringo.

*Parts used:* i. Leaf juice; ii. Root.

*Therapeutic use(s):* i. Gastric ailments; ii. Rheumatism.

*Mode of use and dose:* i. Leaf juice is diluted with water and given orally to cure gastric ailments. ii. Root paste is applied externally to get relief from pain and swellings of bones due to rheumatism.

**120. Picrorhiza scrophulariiflora** Pennell (Scrophulariaceae); *BSHC* 15559.

*Local name:* Kutki.

*Parts used:* Root.

*Therapeutic use(s):* Blood dysentery.

*Mode of use and dose:* Root paste is diluted with water and given orally to cure blood dysentery and gastro-intestinal disorders.

**121. Plumbago zeylanica** L. (Plumbaginaceae); *S.S.Dash* 20790.

*Local name:* Chitapari.

*Parts used:* Root.

*Therapeutic use(s):* Contraceptive.

*Mode of use and dose:* Tender roots are grounded in to a paste and made in to small pills of 5 gm each. One pill daily taken orally in the evening as contraceptive.

**122. Podophylum hexandrum** Royle (Podophyllaceae); *S.S.Dash* 27029.

*Local name:* Papri.

*Parts used:* Root.

*Therapeutic use(s):* Laxative.

*Mode of use and dose:* About 5 gm root paste is given for one week to cure constipation.

**123. Polygala arillata** L. (Polygalaceae) *S.S.Dash* 20715.

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Anti-dysentery vermifuge.

*Mode of use and dose:* i. Root paste is taken orally to cure chronic dysentery. ii. Root bark and stem bark paste in equal amount taken orally to expel intestinal worms.

**124. Plantago erosa** Wall. ex Roxb. (Plantaginaceae); *S.S.Dash* 22013.

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Astringent.

*Mode of use and dose:* Leaf paste is applied around the external injuries to stop bleeding and also for rapid recovery.

**125. Potentilla saundersiana** (Rosaceae) *S.S.Dash* 22762.

*Local name:* Chiriya phal.

*Parts used:* Root.

*Therapeutic use(s):* Chest pain, cold, fever.

*Mode of use and dose:* Root decoction is used to make a sweet preparation with wheat flour and taken orally to cure cold and chest congestion.

**126. Prunella vulgaris** L. (Lamiaceae); *BSHC* 515.

*Local name:* Not known.

*Parts used:* i. Whole plants; ii. Flowers.

*Therapeutic use(s):* i. Headache, sore throats; ii. Febrifuge.

*Mode of use and dose:* i. Hot plant decoction is inhaled to cure headache due to nasal congestion. ii. Flowers paste is taken orally to cure fever.

**127. Prunus cerasoides** D.Don (Rosaceae); *S.S.Dash* 22096.

*Local name:* Paiyung.



*Parts used:* Bark.

*Therapeutic use(s):* Inflammation.

*Mode of use and dose:* Bark paste is applied externally with Ragi (*Elesine corocana* Gaertn.) flour locally known as *kodu* to cure inflammation due to external injury.

**128. *Przewalskia tangutica* Maxim. (Solanaceae); S.K.Rai 1987.**

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Tympanitis.

*Mode of use and dose:* Root juice is diluted with water and taken orally to cure flatulent and distention of the belly.

**129. *Ranunculus diffusus* DC. (Ranunculaceae) S.S.Dash 20796.**

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Antiseptic, Styptic.

*Mode of use and dose:* Plant paste is applied on and around the external injuries to stop bleeding and also as an antiseptic.

**130. *Reinwardtia indica* Dum (Linaceae); BSHC 13728.**

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Antiseptic and Astringent.

*Mode of use and dose:* Leaf paste is applied externally to cure bleeding wound and also acts as an antiseptic.

**131. *Rhaphidophora glauca* Schott. (Araceae); S.S.Dash 17241.**

*Local name:* Kanshirna.

*Parts used:* Stem.

*Therapeutic use(s):* Body ache.

*Mode of use and dose:* About 100 ml of the stem decoction is taken orally daily for 15 days to cure general body-ache.

**132. *Rheum acuminatum* Hook.f.& Thomson (Polygonaceae); S.S.Dash 18569.**

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* i. Rheumatism; ii. Febrifuge.

*Mode of use and dose:* i. Root decoction boiled with bark of *Cinnamomum tamala* T. Nees and Ebern. and taken orally to cure inflammation due to rheumatism. ii. Root paste is taken orally to cure fever.

**133. *Rhododendron arboreum* Sm. (Ericaceae); S.S.Dash 15094.**

*Local name:* Guras.

*Parts used:* Flower buds.

*Therapeutic use(s):* Dysentery.

*Mode of use and dose:* Paste of flower bud is taken orally to cure blood dysentery.

**134. *Rhus semialata* Murray (Anacardiaceae); S.S.Dash 18872.**

*Local name:* Bakhimlo.

*Parts used:* Fruits.

*Therapeutic use(s):* Blood dysentery.

*Mode of use and dose:* Ripen fruits are made in to paste. About 20 gm. of the paste is diluted with water and taken orally to cure blood dysentery.

**135. *Rhus succedanea* L. (Anacardiaceae); S.S.Dash 17262.**

*Local name:* Rani bhalaya.

*Parts used:* i. Leaf; ii. Leaf + Bark; iii. Branch gall.

*Therapeutic use(s):* i. Viral infection and cough; ii. Dysentery; iii. Expectorants.

*Mode of use and dose:* i. The paste of leaf and branch galls mixed in equal proportion and made into small tablets of 5mg each. Two tablets taken orally trice a day to cure cough. ii. Equal amount of leaf and bark is made into paste and tablets of 10 gm each are made. Two tablets twice a day taken orally to cure blood dysentery. iii. About 25 gm of the paste of branch gall is mixed with a local prepared beer *Chang* and taken orally to expel cough and clear chest congestion.

**136. *Ribes acuminatum* G. Don (Grossulariaceae); S.S.Dash 22796, 22799.**

*Local name:* Chamze.

*Parts used:* i. Leaves; ii. Fruits.

*Therapeutic use(s):* i. Astringent, Antiseptic; ii. Constipation.

*Mode of use and dose:* i. Leaf paste is applied externally on cuts and wound for rapid recovery and as an antiseptic. ii. Fruit paste is taken orally to cure chronic constipation.

**137. *Rubia manjiith* Roxb. ex Flem. (Rubiaceae); S.S.Dash 22021.**

*Local name:* Majito.

*Parts used:* Root.

*Therapeutic use(s):* Leucorrhoea.

*Mode of use and dose:* About 100 gm of roots are crushed and boiled in water to prepare a strong decoction. The decoction is then mixed with *Curcuma longa* L. paste. Two teaspoon of the preparation is taken orally twice a day to reduce excess white discharge.

**138. *Rubus ellipticus* Sm. (Rosaceae); S.S.Dash 22094.**

*Local name:* Aiselu.

*Parts used:* i. Bark; ii. Root

*Therapeutic use(s):* i. Dysentery; ii. Jaundice.

*Mode of use and dose:* i. Equal amount of the bark and tender leaves of the *Psidium guajava* L. is mixed and pounded to a paste. One tea spoon of the paste is taken orally to cure dysentery. ii. Root paste given orally to cure jaundice and liver ailments.

**139. *Rumex dentatus* L. (Polygonaceae); S.S.Dash 22985.**

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Skin blisters.

*Mode of use and dose:* Root decoction is used to wash and applied externally on affected areas to cure painful skin blisters.

**140. *Rumex nepalensis* Spreng. (Polygonaceae); S.S.Dash 22080, 27268.**

*Local name:* Holhaley.

*Parts used:* i. Leaves; ii. Root decoction.

*Therapeutic use(s):* i. Antacids; ii. Food poison.

*Mode of use and dose:* i. About 10 ml of the leaf decoction is taken orally as antacid. Leaf paste given orally to cure stomach upset. ii. Root decoction is taken orally to cure food poison particularly due to indigestion.

**141. *Sanicula elata* Buch.-Ham. ex D.Don (Apiaceae); S.S.Dash 20722.**

*Local name:* Not known.

*Parts used:* i. Whole plant; ii. Flowers.

*Therapeutic use(s):* i. Blood dysentery; ii. Antiseptic, Styptic.

*Mode of use and dose:* i. About 5 gm of plant paste is taken orally to cure blood dysentery. ii. Flower paste is applied on and around external injuries to stop bleeding and as an antiseptic.

**142. *Schima wallichii* (DC.) Korth (Theaceae); S.S.Dash 17243.**

*Local name:* Chilaune.

*Parts used:* Root.

*Therapeutic use(s):* Febrifuge.

*Mode of use and dose:* A small piece of the root is chewed to reduce body temperature during fever.

**143. *Scurrula parasitica* L. (Loranthaceae); BSHC 23513.**

*Local name:* Ajiru.

*Parts used:* Root.

*Therapeutic use(s):* Contraceptive.

*Mode of use and dose:* The root is crushed in to paste with ginger. One teaspoon of the paste is taken orally daily as contraceptive. Concentrated paste of root is taken orally for seven days in empty stomach within 3 weeks of sexual intercourse to prevent pregnancy.

**144. *Solanum torvum* Sw. (Solanaceae); BSHC 11356.**

*Local name:* Barabihi.

*Parts used:* Leaves.

*Therapeutic use(s):* Stomachache, carminative.

*Mode of use and dose:* The leaf and fruits of the plant is boiled and paste is made out of that. One teaspoon of the paste is taken orally to cure stomachache due to indigestion. This dose is also cure flatulent and acts as an appetizer.

**145. *Solanum viarum* Dun (Solanaceae); BSHC 22362.**

*Local name:* Sanabihi.

*Parts used:* Fruits with bark.

*Therapeutic use(s):* i. Cough and cold; ii. Nasal congestion.

*Mode of use and dose:* i. Equal amount fruit and bark is mixed and crushed into a paste. One teaspoon of the paste is taken orally twice daily to cure viral fever and cold. ii. The paste is also inhaled to clear nasal congestion.

**146. *Stellaria patens* D.Don (Caryophyllaceae); S.S.Dash 22034.**

*Local name:* Not known.

*Parts used:* Whole plant.

*Therapeutic use(s):* Piles, hemorrhoids.

*Mode of use and dose:* Plant paste is applied around the anus to get relief from pain in piles and to cure anal fissure.

**147. Swetia chirayita** (Roxb. ex Flem.) Korst (Gentianaceae); *S.S.Dash* 24047.

*Local name:* Chirowta.

*Parts used:* i. Leaves; ii. Root.

*Therapeutic use(s):* i. Febrifuge; ii. Purgative.

*Mode of use and dose:* i. Leaf decoction is taken orally to cure fever. ii. Root paste is applied around boils and carbuncles to easy burst and to speed recovery.

**148. Symplocus glomerata** King (Symplocaceae); *S.S.Dash* 13776.

*Local name:* Kharaney.

*Parts used:* Fruit.

*Therapeutic use(s):* Dysentery.

*Mode of use and dose:* Tablets of about 5 gm of fruit paste are made. Two tablets in each 4 hours taken to cure dysentery.

**149. Taxus baccata** subsp. **wallichiana** (Zucc.) Pilger. (Taxaceae); *BSHC* 22362.

*Local name:* Dhengre salla.

*Parts used:* Bark.

*Therapeutic use(s):* Health tonic.

*Mode of use and dose:* About 30 ml of the bark decoction is mixed with water and is taken orally as general health tonic.

**150. Tetradium fraxinifolium** Wall. ex Royel (Rutaceae ) *S.S.Dash* 17273.

*Local name:* Not known.

*Parts used:* Fruits + Bark.

*Therapeutic use(s):* Dysentery.

*Mode of use and dose:* Equal amount of the fruit and bark is mixed and grounded to a paste. About 10 gm of the paste are taken orally to cure dysentery.

**151. Terminalia myriocarpa** Heurck & Muell.- Arg. (Combretaceae); *S.K.Rai* 18873.

*Local name:* Panisaj.

*Parts used:* Bark.

*Therapeutic use(s):* Strangury.

*Mode of use and dose:* Bark of tree, along with bark of *Sygygium cumini* (L.) Skeels (Nep. Jumun) are crushed into paste. Two teaspoon of the paste of diluted with sugarcane juice and taken twice or thrice a day for five days to cure painful urination process. This dose is also prescribed to reduce bad odors in urine.

**152. Thalictrum foliolosum** DC. (Ranunculaceae); *S.S.Dash* 24197.

*Local name:* Not known.

*Parts used:* Root.

*Therapeutic use(s):* Conjunctivitis.

*Mode of use and dose:* Roots of one or two plants are boiled to prepare a decoction. Eyes are washed with this decoction twice a day to cure conjunctivitis.

**153. *Thunbergia grandiflora* Roxb. (Thunbergiaceae); S.S.Dash 14399.**

*Local name:* Not known.

*Parts used:* Leaves.

*Therapeutic use(s):* Carminative.

*Mode of use and dose:* Leaf decoction is taken orally to cure indigestion.

**154. *Thunbergia lutea* (Roxb.) Kuntze (Thunbergiaceae); S.S.Dash 22063, 22041.**

*Local name:* Not known.

*Parts used:* Seeds.

*Therapeutic use(s):* Abortifacient.

*Mode of use and dose:* Seed paste is taken orally within one week of the sexual intercourse for abortion.

**155. *Thysanolaena maxima* (L.) Lam. (Poaceae); S.S.Dash 22066.**

*Local name:* Amlisho.

*Parts used:* Root.

*Therapeutic use(s):* Purgative.

*Mode of use and dose:* Root paste is applied around boil and carbuncles for easy burst and recovery.

**156. *Toddalia asiatica* (L.) Lam. (Rutaceae); BSHC 22569.**

*Local name:* Singanem, Mein Khanra.

*Parts used:* Root.

*Therapeutic use(s):* Diarrhoea.

*Mode of use and dose:* Small pills of 5gm. is made out of the root paste of the plant and taken orally to cure dysentery.

**157. *Trichosanthes lapiniana* Cogn. (Cucurbitaceae); S.S.Dash 22823.**

*Local name:* Indreni.

*Parts used:* i. Seed; ii. Root.

*Therapeutic use(s):* i. Contraceptive; ii. Food poison.

*Mode of use and dose:* i. Seeds are sun dried and powdered. The powder is mixed thoroughly with equal amount of powder of sun dried peeled tubers of *Dioscoria bulbifera* L. About one or two teaspoons of the mixture is taken orally for 7 days after menstruation to prevent pregnancy. ii. The root paste or root decoction of the plant is taken orally to wash the stomach in case of food poison.

**158. *Trichosanthes tricuspidata* Lour. (Cucurbitaceae); S.S.Dash 22823(A).**

*Local name:* Indreni.

*Parts used:* Fruit.

*Therapeutic use(s):* Asthma, bronchitis.

*Mode of use and dose:* Dried fruit powder smoked to cure bronchitis.

**159. *Urtica dioica* L. (Urticaceae); S.S.Dash 22064.**

*Local name:* Sishnu.

*Parts used:* Root.

*Therapeutic use(s):* Purgative.

*Mode of use and dose:* Root paste is applied around boil and carbuncles for easy burst and recovery.

**160. *Urtica parviflora* Roxb. (Urticaceae); S.S.Dash 22064.**

*Local name:* Gharia sishnu.

*Parts used:* Root.

*Therapeutic use(s):* Inflammation.

*Mode of use and dose:* Root paste applied externally to cure inflammation.

**161. *Valeriana hardwickii* Wall. (Valerianaceae). BSHC 17303.**

*Local name:* Chammaha.

*Parts used:* Root.

*Therapeutic use(s):* Antiseptic.

*Mode of use and dose:* The roots are crushed in to a paste and applied externally as antiseptic.

**162. *Viola thomsonii* Oudem. (Violaceae); S.S.Dash 17256.**

*Local name:* Heele.

*Parts used:* Leaf.

*Therapeutic use(s):* Eczema, fungal infection and other skin diseases.

*Mode of use and dose:* Leaf juice is applied around the affected area to cure skin blisters and ailments due to fungal infection.

**163. *Viscum articulatum* Burm.f. (Loranthaceae); S.S.Dash 12730.**

*Local name:* Harchur.

*Parts used:* i. Root; ii. Leaves.

*Therapeutic use(s):* i. Aphrodisiac; ii. Minor bone fracture.

*Mode of use and dose:* i. Roots of the plant along with fruits of *Piper peepuloides* Roxb. (Nep. Rukh peepul) are grounded to a paste. Small pills of 5 gm each are made out of the paste and taken orally within 3 weeks of sexual intercourse to prevent pregnancy. ii. Leaves are crushed with bark of *Mucuna pruriens* (L.) DC. and when taken orally believed to be aphrodisiac. ii. Leaf paste is used to make plaster around the affected area with the help of bamboos and wet cloth. Then the plaster is left for 15 days to cure minor bone fractures.

**164. *Vitex negundo* L. (Verbenaceae). S.S.Dash 20345.**

*Local name:* Siwali.

*Parts used:* Leaf.

*Therapeutic use(s):* Earache.

*Mode of use and dose:* Two drops of leaf juice is poured in the ears to cure earache.

**165. *Wrightia arborea* (Dennst.) D.J. Mabberley (Apocynaceae).**

*Local name:* Karingi, Khira.

*Parts used:* i. Root; ii. Bark.

*Therapeutic use(s):* Abdominal pain during menses, ii. Emmenagogue.

*Mode of use and dose:* i. Root bark is grounded with 5-8 seeds of *Piper nigrum* L. and taken orally twice daily for relieve of abdominal pain. ii. Bark of the plant is grounded to a fine paste, one teaspoon of the paste is taken orally daily twice for 7 days to regularize menses.

**166. *Zanthoxylum armatum* DC. (Rutaceae); BSHC 3456.**

*Local name:* Bale timur.

*Parts used:* i. Leaves; ii. Seeds

*Therapeutic use(s):* i. Indigestion; ii. Anthelmintic.

*Mode of use and dose:* i. About 10 ml of the leaf decoction is taken orally twice a day to cure indigestion and acidity. ii. Seed paste is given orally to infants to expel intestinal worms.

**167. *Zanthoxylum acanthopodium* DC. (Rutaceae); S.S.Dash 13777.**

*Local name:* Bokey timbur.

*Parts used:* Fruit.

*Therapeutic use(s):* Toothache.

*Mode of use and dose:* Fruit powder is used for brushing teeth to reduce toothache.

## RESULTS

The ethnobotanical information gathered reveals 225 different uses of 167 plant species belonging to 84 families for the treatment of 27 major ailments. The plants species are presented in alphabetical order followed by the family name, collection number, vernacular name (mostly in Nepali), the parts used, the therapeutic symptoms for which the plants were used and the methods of preparation of doses. Herbs are represented by approximately 50% of the total species, followed by trees (25.7%) and shrubs (16.7%); while climbers constitute the lowest habitat category (8.38%). Out of the total species, 106 species show their range of distribution in tropical and sub-tropical region, 26 species found in temperate region, 16 species found in alpine region while 19 species found in transitional belts.

Table - I : Medicinal plants arranged by habitats

Habitat	Total species	Percentage
Herbs	82	49.1
Shrubs	28	16.76
Trees	43	25.75
Climber	14	8.39
<b>Total</b>	<b>167</b>	<b>100</b>

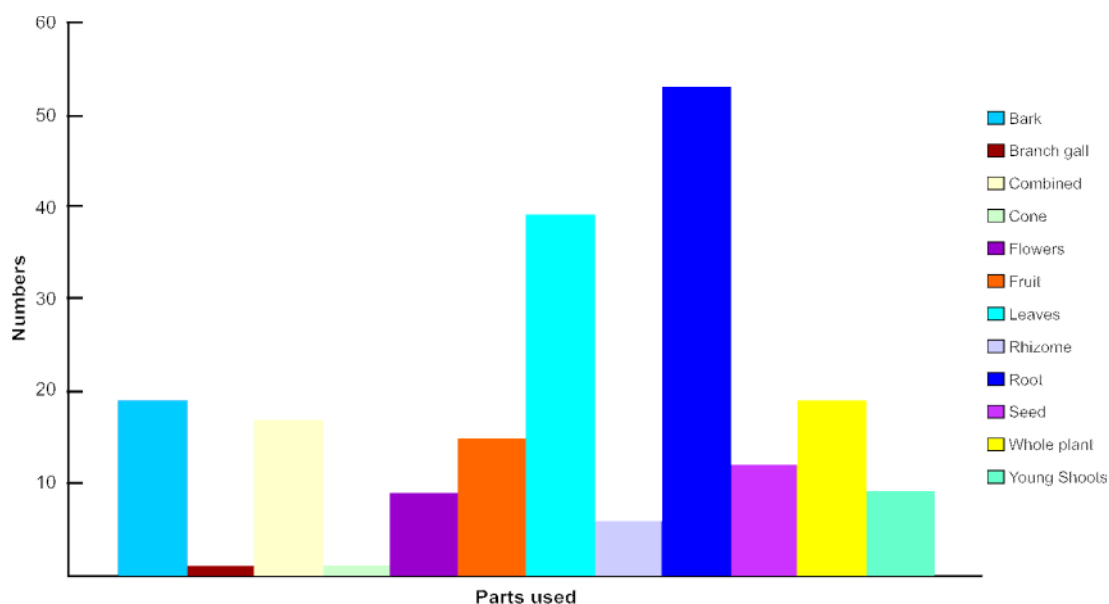
### *Plant parts used :*

The plant parts used for different ailments bark, flowers, fruits, leaves, rhizomes, seed, stems and young shoots. Herbs were mostly used as whole, while in case of trees, the parts were used differently. (**Fig. -1**). It is interesting to note that there were 17 types of medicines which were used in combinations of different parts.

Roots are used most frequently, may be due to their high concentration of bioactive compounds (Anonymous 1966, Bauvaldo & al., 1995; Robinson, 1974). It is significant to note that uprooting of plants or removal of roots is the main cause of loss of a particular species.

### *Ailments treated :*

All total 28 ailments were treated. Instances are there that single plant is used for different ailments in different combination and different doses. *The table-II* show the different ailments and the plants or plant parts used for treatment.



**Fig.- 1:** Plant parts used in preparation of different medicines and doses.

**Table- II:** Medicinal Plants used various ailments

Sl. No.	Therapeutic use(s)/ Diseases symptoms	Plants used
1.	Anthelmintic	<i>Aconitum heterophyllum</i> , <i>Aphanamixis polystachya</i> , <i>Hedera nepalensis</i> , <i>Zanthoxylum armatum</i> ,
2.	Antidotes	<i>Berberis wallichii</i> , <i>Datura metel</i> , <i>Eurya acuminata</i> , <i>Galinsoga parviflora</i>
3.	Antiseptic, Cut & Wounds/Styptic	<i>Achyranthes bidentata</i> , <i>Ageratum conyzoides</i> , <i>Anaphalis contorta</i> , <i>Artemisia nilagirica</i> , <i>Centella asiatica</i> , <i>Circaea alpina</i> , <i>Clinopodium umbrosum</i> , <i>Colebrookea oppositifolia</i> , <i>Didymocarpus pedicellata</i> , <i>Eupatorium adenophorum</i> , <i>Eupatorium cannabinum</i> , <i>Ranunculus diffusus</i> , <i>Reinwordtia indica</i> , <i>Sanicula elata</i> , <i>Terminalia myriocarpa</i> , <i>Stellaria patens</i> , <i>Valeriana hardwickii</i>
4.	Aphrodisiac/ Libido	<i>Dalbergia latifolia</i> , <i>Hedera nepalensis</i> , <i>Panax pseudoginseng</i> , <i>Viscum articulatum</i>
5.	Arbortifacient	<i>Abrus precatorius</i> , <i>Thunbergia lutea</i>
6.	Asthma/Bronchitis and Respiratory problems	<i>Betula utilis</i> , <i>Clematis wightiana</i> , <i>Clematis buchananiana</i> , <i>Desmodium elegans</i> , <i>Ephedra gerardiniana</i> , <i>Girardinia diversifolia</i> , <i>Rhus semialata</i> , <i>Solanum viarum</i> , <i>Trichosanthes tricuspidata</i>
7.	Astringent	<i>Bistorta affinis</i> , <i>Bistorta vivipara</i> , <i>Dichrocephala integrifolia</i> , <i>Osbeckia nepalensis</i> , <i>Plantago erosa</i> , <i>Ribes acuminatum</i>
8.	Carminative	<i>Clematis wightiana</i> , <i>Solanum torvum</i> , <i>Thunbergia grandiflora</i> , <i>Zanthoxylum armatum</i>
9.	Conjunctivitis	<i>Berberis aristata</i> , <i>Thalictrum foliosum</i>
10.	Contraceptives	<i>Butea monosperma</i> , <i>Croton caudatus</i> , <i>Michelia doltisopa</i> , <i>Oroxylum indicum</i> , <i>Plumbago zeylanica</i> , <i>Scurrula parasitica</i> , <i>Trichosanthes lapiniana</i>
11.	Dental care	<i>Abies densa</i> , <i>Zanthoxylum acanthopodium</i>
12.	Dermatological use/ Skin disorders	<i>Clematis buchananiana</i> , <i>Equisetum diffusum</i> , <i>Gmelina arborea</i> , <i>Juniperus recurva</i> , <i>Lyonia ovalifolia</i> , <i>Rumex dentatus</i> , <i>Viola thomsoni</i>
13.	Diarrhoea & Dysentery	<i>Agrimonia pilosa</i> , <i>Berginia ciliata</i> , <i>Bistorta amplexicaule</i> , <i>Cinnamomum tamala</i> , <i>Picrorhiza scrophulariiflora</i> , <i>Polygala arillata</i> , <i>Rhododendron arboreum</i> , <i>Rhus semialata</i> , <i>Rubus ellipticus</i> , <i>Sanicula elata</i> , <i>Symplocus glomerata</i> , <i>Tetradium fraxinifolium</i> , <i>Toddalia asiatica</i> ,



Sl. No.	Therapeutic use(s)/ Diseases symptoms	Plants used
14.	Diuretic	<i>Ajuga bracteosa</i> , <i>Bombax ceiba</i> , <i>Coix lachryma-jobi</i> , <i>Daphne bholua</i> , <i>Desmodium elegans</i> , <i>Ilex dipyrena</i> , <i>Laportea terminalis</i> , <i>Mahonia nepalensis</i> , <i>Ophiorrhiza treutleri</i> .
15.	ENT problems	<i>Bergenia purpurascens</i> , <i>Bidens pilosa</i> , <i>Bistorta vivipara</i> , <i>Flascopea scandens</i> , <i>Hemiphragma heterophyllum</i> , <i>Hippophae salicifolia</i> , <i>Juglans regia</i> , <i>Vitex negundo</i>
16.	Febrifuge, Cold and cough	<i>Abelmoschus manihot</i> , <i>Abrus precatorius</i> , <i>Acoros calamus</i> , <i>Artemisia nilagirica</i> , <i>Ammomum subulatum</i> , <i>Begonia cathcartii</i> , <i>Brugmansia suaveolens</i> , <i>Dichroa febrifuga</i> , <i>Drymaria cordata</i> , <i>Gmelina arborea</i> , <i>Heracleum wallichii</i> , <i>Nasturtium officinale</i> , <i>Potentilla saundersiana</i> , <i>Prunella vulgaris</i> , <i>Rheum acuminatum</i> , <i>Schima wallichii</i> , <i>Swertia chirayita</i> , <i>Solanum viarum</i>
17.	Galactagogue	<i>Alstonia scholaris</i> , <i>Cleome viscosa</i> , <i>Costus speciosus</i> , <i>Oxalis corniculata</i>
18.	Gastro-intestinal ailments	<i>Agrimonia pilosa</i> , <i>Ainsliaea latifolia</i> , <i>Bidens pilosa</i> , <i>Bergenia purpurascens</i> , <i>Callicarpa arborea</i> , <i>Cannavis sativa</i> , <i>Cissampelos pareira</i> , <i>Coelogyne fuscescens</i> , <i>Hedychium spicatum</i> , <i>Houttuynia cordata</i> , <i>Juniperus recurva</i> , <i>Litsea cubela</i> , <i>Nardostachys grandiflora</i> , <i>Phytolacca acinosa</i> , <i>Przewalskia tangutica</i> , <i>Solanum torvum</i>
19.	Gynecological disorders	<i>Abies densa</i> , <i>Abroma augusta</i> , <i>Abrus precatorius</i> , <i>Alangium chinense</i> , <i>Amaranthus spinosus</i> , <i>Astilbe rivularis</i> , <i>Berginia ciliata</i> , <i>Bombax ceiba</i> , <i>Butea monosperma</i> , <i>Caesalpinia bonduc</i> , <i>Clerodendrum infortunatum</i> , <i>Dendrocalamus hamiltonii</i> , <i>Gloriosa superba</i> , <i>Oroxylum indicum</i> , <i>Persicaria hydropiper</i> , <i>Rubia manjiith</i> , <i>Wrightia arborea</i>
20.	Jaundice and Liver disorders	<i>Betula alnoides</i> , <i>Cissampelos pareira</i> , <i>Rubus ellipticus</i>
21.	Laxatives	<i>Belamcanda chinensis</i> , <i>Fraxinus floribunda</i> , <i>Gaultheria nummularioides</i> , <i>Houttuynia cordata</i> , <i>Podophyllum hexandrum</i> , <i>Ribes acuminatum</i>
22.	Muscular pain/ Anti- inflammation	<i>Astilbe rivularis</i> , <i>Betula alnoides</i> , <i>Bidens pilosa</i> , <i>Bischofia javanica</i> , <i>Bistorta affinis</i> , <i>Boenninghausenia albiflora</i> , <i>Buddleja asiatica</i> , <i>Cuscuta reflexa</i> , <i>Cyathea spinulosa</i> , <i>Dichroa febrifuga</i> , <i>Dioscorea belophylla</i> , <i>Eupatorium adenophorum</i> , <i>Heracleum wallichii</i> , <i>Prunus cerasoides</i> , <i>Rhaphidophora glauca</i> , <i>Urtica parviflora</i> ,
23.	Pre & post natal care	<i>Aphanamixis polystachya</i> , <i>Campylandra aurantiaca</i> , <i>Costus speciosus</i> , <i>Elephantopus scaber</i> , <i>Gloriosa superba</i> , <i>Michelia champak</i> , <i>Taxus baccata</i> var <i>wallichiana</i>
24.	Purgative	<i>Ajuga bracteosa</i> , <i>Girardinia diversiflora</i> , <i>Ficus semicordata</i> , <i>Iris clarki</i> , <i>Swertia chirayita</i> , <i>Thysanolaena maxima</i> , <i>Urtica dioica</i>
25.	Rheumatism	<i>Aconitum ferox</i> , <i>Caltha palustris</i> , <i>Cassia fistula</i> , <i>Erythrina arborescens</i> , <i>Eurya acuminata</i> , <i>Murraya koenigia</i> , <i>Phytolacca acinosa</i> , <i>Rheum acuminatum</i>
26.	Veterinary use	<i>Anemone rivularis</i> , <i>Capsella bursa-pastoris</i> , <i>Maesa chisia</i> ,
27.	Others	<i>Berginia ciliata</i> , <i>Centella asiatica</i> , <i>Rumex dentatus</i> , <i>Trichosanthes lapiniana</i> , <i>Viscum articulatum</i>

## DISCUSSION

During the open ended interviews it was revealed that the use of plants for common ailments viz. cough & cold, nasal congestion, fever, pain reliever were quite familiar to most of the inhabitants. However, knowledge regarding complicated ailments like gynecological problems, ailments dealing with infants, pregnancy, pre & post natal treatment were known to a particular section of the people; some of which serve as local herbal healer. This kind of traditional curative knowledge was usually inherited in a family which kept the information

for secret for generation to generation in a belief that the remedial effect of the medicines would loose its potency if disclosed to other people (Dash, 1994). Similar observations were also made by others in Himalayan region (Shrestha & Dhillon, 2003; Bhat & al., 1990; Jain & Salkani, 1991).

All the treatments were based on the medicines prepared from single plant. However 16 medicinal remedies were based on the mixture of two or three plants. The preparation of doses included powder, decoction, paste, raw plant material (unprocessed), smoke and juice. About 62% of remedies were cured by paste, 17% were cured by decoctions while 19% of remedies were cured by other applications. Like wise the decoction was made by boiling of the parts of whole plant to a thick solution.

Use of the drug includes oral administration, inhalation, poultice, external application and massage. Most of the medicines are administrated orally, while poultice of the 21% of the plants are applied externally. Internal uses of medicines were maximum in the gastro-intestinal ailments while external application was maximum in skeleto-muscular and dermatological ailments. Similar findings were also reported from other parts of the world (Bonet & al., 1992; Raja & al., 1997).

Some of the interesting remedies were *Centella asiatica* L. used for controlling blood pressure, *Costus speciosus* used for reducing breast swelling, *Rubus ellipticus* used for jaundice, *Gynocardia odorata* used for epilepsy and *Berberis wallichii* used for mad dog bite. The high use of plants for gynecological disorders reflects the socio-economic condition of the people inhabited in this region.

It is very difficult to assess the effectiveness of the herbal medicines. Literature survey revealed that some of the plants practiced by the people are likely to be effective; for example seeds of *Abrus precatorius* contain alkaloid abrine, which is mild poison, the dose used for abortion. The use of *Aconitum ferox* against epilepsy is supported by the presece of a toxic alkaloid pseudo-aconitine which has an antidepressant effect on central nervous system. (Anonymous 1956). Use of *Dichroa febrifuga* as antipyretic supported the presence of a bitter substance and possess anti malarial activity. Similarly the use of *Swertia chirayita* for fever is substantiated by presence of a bitter substance *Chiratin* (Anonymous 1956). The application of leaf juice of *Eupatorium adenophorum* externally to stop bleeding is supported by presence of a haemostatic substance ayapanin (Bose & Roy, 1936). However, the purpose of this paper is not to prescribe any remedy against any diseases but to report the traditional uses of the plants; which would be screened and tested by the pharmacogist before used as medicines.

## CONCLUSION

Sikkim is one of the smallest States of India not fully explored ethnobotanically. Many parts of the State are inaccessible and modern health care is not easily available. The recorded information was gathered mainly from the rural sectors of the state and not reported from the earlier published data. The local names of the plants are different from place to place but the uses are same.

In recent years the rural folk have started discarding their traditions including the herbal remedies. The use of the plants has also declined due to scarcity of medicinal plants in the region. Over exploitation of the plants for domestic as well as commercial uses is also a great threat. The opening up of several high altitude areas like Nathula, Gurudangmar lake, Chola mau lake, Dzongri ect. to tourists in Sikkim has also affected the microclimatic conditions of these fragile ecosystems. Overgrazing and large scale timber extractions are also major threats to the existing biodiversity. Legal as well as illegal trade of some important medicinal plants viz. *Picrorhiza scrophulariiflora*, *Nardostachys grandiflora*, *Aconitum spp*, *Swertia chirayita*, *Podophyllum hexandrum* and *Taxus wallichiana* have already endangered many unique populations of these species in the region.

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## सिक्किम, भारत में पारम्परिक शाकीय उपचार

एस.एस. दाश

### सार संक्षेप

शोधपत्र में सिक्किम के दस ग्रामीण समुदायों द्वारा 27 प्रमुख रोगों के उपचार के लिए 84 कुलों की 167 पादप जातियों के विभिन्न 225 उपयोग दिए गए हैं। संग्रह की गई सारी सूचना सिक्किम के चुने हुए प्रतिनिधि गाँवों के शाकीय उपयोग पर आधारित थी। संग्रह के सिलसिले में पारम्परिक उपयोग प्रणाली, उपयोग में आनेवाले भाग, तैयार करने की पद्धति और खुराक पर भी चर्चा हुई। उपयोग में आने वाले कुल पौधों में 50% शाक, 25% वृक्ष, 17% क्षुप तथा 8% लताएँ हैं। अधिकांश शाकीय औषधि में एक पौधा या उसके विशेष भाग का लेप बनाकर उपयोग किया जाता है। काढ़ा, चूर्ण या साँस से ग्रहण कुछ अन्य प्रणाली हैं। सामान्य रोगों के उपचार हर घर के लोग जानते थे। कठिन रोगों की औषधि या खुराक शाकीय चिकित्सक या 'जकरी' की सलाह से लिये जाते थे। वर्तमान अध्ययन से संकेत मिला है कि इस अंचल में औषधीय पौधों की प्रचुर विविधता है। स्थानीय नाम, स्वभाव (हेबीट), फूल एवं फल लगने की अवधि, पौधे की उपयोगी भाग, औषधिय गुण, उपयोग प्रणाली के साथ 167 पादप जातियों की सूची भी दी गई है।

## GENUS *COLOLEJEUNEA* (SPRUCE) SCHIFFN. IN NILGIRI HILLS (WESTERN GHATS)

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### ABSTRACT

The present paper deals with the status of the *Cololejeunea* (Spruce) Schiffn. in Nilgiri hills of Western Ghats. Till date the genus is represented in Nilgiri hills by 5 species *Cololejeunea nilgiriensis* G. Asthana & S. C. Srivast., *C. latilobula* (Herzog) Tixier, *C. minutissima* (Sm.) Schiffn. *C. appressa* (A. Evans) Benedix and *C. pseudofloccosa* (Horik.) Benedix. Recent investigations have however, shown the presence of two more species, *C. udarii* G. Asthana & S. C. Srivast. and *C. cardiocarpa* (Mont.) A. Evans.

**Keywords:** Bryophyta, *Cololejeunea*, Hepaticae, Nilgiri hills, Western Ghats.

### INTRODUCTION

The Nilgiri hills of Tamil Nadu is considered to be one of the treasurer houses of the bryo-diversity including Hepaticae, Anthocerotae and Musci not only in Western Ghats but also in entire peninsular India. Due to the tropical and subtropical climate, coupled with physical and biotic factors, the area is well suited for the growth and differentiation of Lejeuneaceae, Jubulaceae and Porellaceae. The family Lejeuneaceae has maximum generic as well as species diversity in Nilgiri hills. The genus *Cololejeunea* (subfamily Cololejeuneoideae) is frequently distributed in tropical and subtropical part of the world and mostly found as epiphytic population more commonly as foliicolous (epiphyllous) form and less so corticolous (Pócs, 1982). The genus is one of the most delicate among the hepaticae and is characterized by hyaline nature of leaf, lack of underleaves and highly reduced stem anatomy (*i.e.* comprising only single medullary cell surrounded by cortical cells) and asexual reproduction by means of discoid gemmae occurring exogenously on leaf surface. In India the genus has a rich diversity with 30 validly recognized species. The South Indian territory is represented with 22 species of which 5 species are known from Nilgiri, *Cololejeunea latilobula* (Herzog) Tixier, *C. nilgiriensis* G. Asthana & S. C. Srivast., *C. minutissima* (Sm.) Schiffn., *C. appressa* (A. Evans) Benedix and *C. pseudofloccosa* (Horik.) Benedix (Asthana & Srivastava, 2003). During a recent exploration in the area two more species of genus *Cololejeunea*, *C. cardiocarpa* (Mont.) A. Evans, and *C. udarii* G. Asthana & S. C. Srivast. were collected from Nilgiri hills making a total of 7 species in the area. The paper also discusses the peculiarities of the species with range of distribution in India as well as abroad.

#### Key to subgenera and species of genus *Cololejeunea*

- 1a. Plants small (up to 2 mm long), fragile in nature;  
branching athecal, *Aphanolejeunea*-type;  
leaves distantly arranged ...*Cololejeunea* subgen. *Aphanolejeunea* (*C. nilgiriensis*)
- 1b. Plants medium to long (4 mm to 16 mm long);  
branching thecal, *Lejeunea* type, leaves  
sub-imbricate to closely imbricate ...2
- 2a. Leaves with dimorphic leaf-lobule, ligulate  
or inflated; leaf-lobe margin with elongated,  
hyaline cells ...*Cololejeunea* subgen. *Pedinolejeunea*...3
- 2b. Leaves with monomorphic leaf-lobule, only inflated,  
lingulate lobule absent, leaf-lobe margin crenate  
(hyaline cell always absent) ...5

- 3a. Marginal hyaline cells of leaf-lobule elongated  
(finger like projection); in cluster at the tip of apex ...*C. cardiocarpa*
- 3b. Marginal cells of leaf-lobe rectangulate, present all along the margin ...4
- 4a. Leaf-lobule lingulate to triangulate, with defined first tooth, while second tooth absent ...*C. latilobula*
- 4b. Leaf-lobule variable, lingulate to inflated, with distinct first and second tooth ...*C. udarii*
- 5a. Dorsal pappilosity on leaf-cells absent,  
plants loosely appressed ...*Cololejeunea* subgen. *Leptocolea* (*C. minutissima*)
- 5b. Dorsal pappilosity on leaf-cells well developed and  
prominently present throughout all the leaves, plants  
closely appressed *Cololejeunea* subgen. *Taeniolejeunea* ...6
- 6a. Vitta present, first tooth larger than second tooth ...*C. appressa*
- 6b. Vitta absent, second tooth larger than the first tooth *C. pseudofloccosa*

**1. *Cololejeunea nilgiriensis*** G. Asthana & S. C. Srivast., Bryophytorum Bibliotheca 60: 27. 2003.

*Type locality* : India (Tamil Nadu-Avalanche).

*Range* : Endemic to India (Nilgiri hills).

*Distribution* : India : South India: Tamil Nadu-Nilgiri hills (Avalanche, Ebanadu, Ketabettu (see also Asthana and Srivastava, 2003).

*Specimen examined* : Western Ghats: Tamil Nadu: Nilgiri hills-Coonoor (Ketabettu), 1850-1900 m, 09.04.2002, P.K. Verma, A. Alam and N. Sahu 15330/2002 (LWU).

The species was recently instituted species from Avalanche, Nilgiri hills (Asthana & Srivastava, 2003) and been recently collected from Coonoor (Ketabettu), a new locality from the area. The species is characterized by distantly arranged leaves with crenate margin of leaf lobe and dorsal pappilosity.

**2. *Cololejeunea cardiocarpa*** (Mont.) A. Evans, Mem. Torrey Bot. Club 8: 177. 1902.

*Type locality* : North America (Cuba).

*Range* : Australia, Africa, Central & South America and Asia (see also Wigginton & Grolle, 1996; Verma, 2005).

*Distribution* : India : South India: Kerala-Murukkaddy; Tamil Nadu-Palni hills-Kodaikanal (Periyakulam, Perumalmalai) (see also Asthana & Srivastava, 2003), Nilgiri hills-Singara Tea Estate.

*Specimens examined* : Western Ghats: Tamil Nadu: Nilgiri hills – Coonoor (Singara Tea Estates), 1850 m, 11.10.2000, S.C. Srivastava and party 12828/2000 (LWU).

This species is a new addition to liverwort flora of Nilgiri hills, collected from Coonoor and easily separable from other species of *Cololejeunea* subgen. *Pedinolejeunea* in having finger like elongated non-chlorophyllous cells present at the tip of leaf - lobe. The species was earlier known from Kerala (Murukkaddy) and Tamil Nadu (Palni hills: Periyakulam, Perumalmalai) in south India (Asthana & Srivastava, 2003)

**3. *Cololejeunea latilobula*** (Herzog) Tixier, Bryophytorum Bibliotheca 27: 156. 1986.

*Type locality* : China.

*Range* : Africa and Asia (see also Asthana & Srivastava, 2003).

*Distribution* : India : Western Himalaya: Uttarakhand: Bageshwar, Nainital (Chaubatia). Eastern Himalaya: Meghalaya-Cherrapunji. Central India: Madhya Pradesh (Pachmarhi). South India: Karnataka-Mercara, Jog falls, Agumbe; Kerala-Trichur (Peechi dam), Kottayam, Murukkaddy, Thekkady, Trivandrum; Tamil Nadu - Nilgiri hills (Kendurai, Kalahatty slope, Sim's park; Palni hills – Kodaikanal (Periyakulam) (see also Asthana & Srivastava, 2003).

*Specimens examined* : Western Ghats: Tamil Nadu: Nilgiri hills-Kalahatty slope reserve forest, 1600-1800 m, 26.03.2001, P.K. Verma and A. Alam 13525/2001 (LWU). Kendurai, 2100 m, 28.03.2003, P.K. Verma and A. Alam 16775/2003, 16776/2003, 16777/2003 (LWU).

Initially this species was reported from India as *Leptocolea himalayensis* (= *Cololejeunea himalayensis*) by Pande and Misra (1943) from Uttarakhand. It is and extensively distributed in all four major bryogeographical regions of the country. Recently Zhu and So (2001) reduced it as synonymies under *Cololejeunea latilobula* (see also Asthana & Srivastava, 2003).

**4. *Cololejeunea udarii* G. Asthana & S. C. Srivast., Bryophytorum Bibliotheca 60: 40. 2003.**

*Type locality* : India: Karnataka (Jog falls).

*Range* : Endemic to India.

*Distribution* : India : Eastern Himalaya: Assam; Arunachal Pradesh (Yingkiyong, Siang-Shimar forest). South India: Karnataka-Jog falls, Agumbe (see Asthana & Srivastava, 2003); Tamil Nadu-Nilgiri hills (Avalanche).

*Specimen examined* : Western Ghats: Tamil Nadu: Nilgiri hills-Avalanche, 2200 m, 09.10.2000, S.C. Srivastava and party 12563/2000 (LWU).

*Cololejeunea udarii* instituted from Jog falls, Karnataka (Asthana & Srivastava, 2003), shows an extended range of distribution in Nilgiri hills (Avalanche). The species is characterized by hyaline marginal cells present only along the antical margin and dimorphic leaf-lobule (lingulate to inflated).

**5. *Cololejeunea minutissima* (Sm.) Schiffn., Engler and Prantl, English Bot. Pl. 1633. 1806.**

*Type locality* : Great Britain.

*Range* : Australia, Africa, Asia, Europe, North and South America (see also Asthana & Srivastava, 2003; Mizutani, 1980, 1984).

*Distribution* : India : Eastern Himalaya: Meghalaya-Shillong (Vishnupur); West Bengal. South India: Karnataka-Mercara; Kerala-Thekkady, Murukkaddy, Trivandrum; Tamil Nadu-Nilgiri hills (Parson's valley, Emerald, Kendurai, Government Botanical Garden, Avalanche; Palni hills-Kodaikanal).

*Specimens examined* : Western Ghats: Tamil Nadu: Nilgiri hills - Ootacamund (Kendurai), 2100-2200 m, 30.03.2003, P.K. Verma and A. Alam 16771/2003, 16772/2003, 16773/2003, 16776/2003 (LWU).

This species was earlier reported from Nilgiri hills as *Lejeunea minutissima* (Mitten, 1861). Now it is one of the most abundant species of the genus in Nilgiri hills and seems closer to genus *Microlejeunea*, especially *M. ulicina* (Lejeuneoideae) because of its nature of appearance. The species is characterized by small plant, bidentate inflated leaf-lobule, with 2 celled first tooth.

**6. *Cololejeunea pseudofloccosa* (Horik.) Benedix, Feddes Repert. 134: 36. 1953.**

*Type locality* : Taiwan.

*Range* : Australia and Asia (see Zhu & So, 2001).

*Distribution* : India: Eastern Himalaya: Arunachal Pradesh-E. Siang, Shimar forest; Sikkim; West Bengal-Darjeeling (Rimbic); Meghalaya-Cherrapunji. South India: Tamil Nadu-Nilgiri hills (Avalanche, Coonoor) (see also Asthana & Srivastava, 2003; Verma, 2005).

*Specimen examined*: Western Ghats: Tamil Nadu: Nilgiri hills –Upper Bhavani (Avalanche), 2200 m, 09.10.2000, S.C. Srivastava and party 12563/2000 (LWU).

*Cololejeunea pseudofloccosa* was recently reported from Avalanche, Nilgiri hills (Asthana & Srivastava, 2003). The species is characterized by leaf lobule morphology where the first tooth of leaf-lobule is crossed over by the second tooth.

**7. *Cololejeunea appressa* (A. Evans) Benedix, Feddes Repert. Beih. 134: 31. 1953.**

*Type locality* : Jamaica.

*Range*: Africa, Asia and South America (see also Zhu & So, 2001).

*Distribution* : India : Eastern Himalaya: Meghalaya-Cherrapunji, Shillong (Elephant falls); West Bengal – Darjeeling, Jorpokhri. South India: Karnataka-Agumbe, Jog falls; Tamil Nadu-Nilgiri hills [Kotagiri (Shollarmattum), Gudulur (Naduvattam reserve forest), Ootacamund (Ebanadu), Upper Bhavani (Avalanche)]; Palni hills-Kodaikanal, (Perumalmalai); Andaman and Nicobar Isl. (see also Asthana & Srivastava, 2003).

*Specimen examined* : Western Ghats: Tamil Nadu: Nilgiri hills-Avalanche, 2200 m, 09.10.2000, S.C. Srivastava and party 12563/2000 (LWU).

The species was initially reported from Avalanche, Nilgiri hills (Asthana & Srivastava, 2003). It has also been collected from Gudulur and Coonoor. The species is characterized by 4 celled uniseriate vitta and papillosity of the leaf.

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### नीलगिरी पहाड़ियों ( पश्चिमी घाट ) में वंश कोलोलिज्युनिया ( स्प्रूस ) शिफन.

प्रवीण कुमार वर्मा

#### सार संक्षेप

नील गिरि पहाड़ियों ( पश्चिमी घाट ) में कोलोलिज्युनिया ( स्प्रूस ) शिफन. के स्थिति का वर्णन है। अभी तक नीलगिरी पहाड़ियों में इस वंश की 5 जातियां हैं : कोलोलिज्युनिया नीलगिरिएंसिस, कोलोलिज्युनिया लेटिलोबुला, कोलोलिज्युनिया मिनुटिस्सिमा, कोलोलिज्युनिया एप्रेस, कोलोलिज्युनिया स्प्रूडोफ्लोक्सोसा हाल की गवेषणा में दो और जातियां मिली हैं: कोलोलिज्युनिया उडारी एवं कोलोलिज्युनिया कार्डियोकार्पा।



## TAXONOMIC ASSESSMENT OF FAMILY BRYACEAE (BRYOPSIDA) OF PACHMARHI BIOSPHERE RESERVE (MADHYA PRADESH), INDIA

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### ABSTRACT

Nine taxa belonging to Bryaceae: *Anomobryum auratum* (Mitt.) Jaeg., *Brachymenium acuminatum* Harv., *Brachymenium ptychothecium* (Besch.) Ochi, *Bryum argenteum* Hedw., *Bryum caespiticium* L. ex Hedw., *Bryum capillare* L. ex Hedw., *Bryum coronatum* Schwaegr., *Bryum paradoxum* var. *reflexifolium* (Ochi) Ochi and *Pohlia flexuosa* Hook., growing on various habitats in Pachmarhi Biosphere Reserve (PBR), between altitude 800-1060 meters have been assessed. These mosses are being reported from the Pachmarhi Biosphere Reserve for the first time.

**Keywords :** Bryaceae, Bryopsida, Pachmari.

### INTRODUCTION

Bryaceae is one of the largest families of mosses (Bryopsida) with worldwide distribution of 13 genera and 850 species (Shaw 1985). It includes erect mosses with generally sparsely branched stems. There is extensive variation among the members of the family in leaf shape, shape of cells and capsules and development of capsule (from perfect to absent). The family was divided by Brotherus (1924) into 3 subfamilies viz. Orthodontioideae, Bryoideae and Melichhoferioideae. Andrews (1935) and Ochi (1959) have divided Bryaceae into two subfamilies: Bryoideae and Pohliodeae. Gangulee (1977) has followed the two subfamily classification and described 10 genera of the family from India. However, Lal (2005) has listed 11 genera under this family from India viz. *Anomobryum* Schimp., *Bryum* Hedw., *Brachymenium* Schwaegr. *Epipterygeum* Lindb., *Leptobryum* (B.S.G) Wilson, *Mielichhobryum* Srivastava, *Mielichhoferia* Nees & Hornsch, *Mniobryum* Limpr., *Plagiobryum* Lindb., *Pohlia* Hedw., *Rhodobryum* (Schimp.) Limpr.

Bryaceae is often considered a taxonomically difficult family. Some workers have extensively worked on it and revised several genera of the family. Traditional generic concepts in the family as exemplified by those of Brotherus (1924) are based sometimes on gametophytic and at other times on sporophytic characters. Later, several workers have worked on various genera. Ochi (1959, 1972, 1972a,) has revised *Bryum* and related genera. Crundwell and Nyholm (1964), Syed (1973) and Mohammed (1979) revised several groups of the family. Shaw and Fife (1984) discussed peristome variation and taxonomy in *Anomobryum*.

The central Indian zone is rich in terms of bryoflora. Mosses of the central Indian region have been studied and described by several authors, Nath & al. (2005, 2007, 2008), Chaudhary and Sharma (2002), Chaudhary and Deora (1996, 2001), Bapna (1975). But the mosses of the Pachmarhi Biosphere Reserve have not been explored to a satisfactory extent. Pachmarhi Biosphere Reserve is situated in Madhya Pradesh, covering three civil districts - Chhindwara, Betul and Hoshangabad, undertaking an area of 4987.38 square kms. This region is of great importance due to the fact that this area lies in what was known in the past as the Gondwanaland and its age can be calculated to the Triassic period. The flora and fauna of the region thus hold much importance phylogenetically. Further, the region also forms a link between the biodiversity of the southern Indian region and that of the Himalayan region, and this makes the Biosphere Reserve a connecting link between the two belts. Nearly 57 species of liverworts, 37 species of epiphytic mosses and 46 species of terrestrial mosses have been reported from there so far (Singh and Kaul 2002). Family Bryaceae shows considerable representation as evident from 9 taxa belonging to 4 genera being encountered from here. The genus *Bryum* is represented by 5 species namely *B. argenteum* Hedw., *B. caespiticium* L. ex Hedw., *B. capillare* L. ex Hedw., *B. coronatum* Schwaegr. and *B. paradoxum* var. *reflexifolium* (Ochi) Ochi. The genus *Brachymenium* is represented by only 2 species viz. *B. acuminatum* Harv. and *B. ptychothecium* (Besch.) Ochi whereas, genus *Anomobryum* and *Pohlia* are represented by one species each, *A. auratum*

(Mitt.) Jaeg and *P. flexuosa* Hook. respectively. Previously, Singh and Kaul (2002) reported 4 genera viz. *Anomobryum*, *Brachymenium*, *Bryum* and *Pohlia* of this family from the Biosphere Reserve area.

### MATERIALS AND METHODS

The specimens were collected in the successive years in 1992, 1993 and 2006 respectively from 10 localities situated at an altitudinal range between 800 to 1060 m, of the Biosphere Reserve. The specimens were collected from terrestrial habitats such as rocks, soil covered rocks and wet rocks etc. and have been deposited in the Bryophyte Herbarium, NBRI, Lucknow (LWG).

#### Key to the genera

- 1a. Plants slender, unbranched, leaf cells in upper & middle region nearly four times as long as broad, basal leaf cells longer 1. ...*Pohlia*
- 1b. Plants frequently branched, leaf cells in middle & upper region not in 4:1 ratio, basal cells abruptly shortening at the base ...2
- 2a. Plants slender, julaceous, long slender sub-floral innovations. leaves small, appressed to stem, costa ending much below leaf apex 2. ...*Anomobryum*
- 2b. Plants moderately robust, non-julaceous, robust sub-floral innovations, leaves longer, erect to erectopatent, costa ex-current ...3
- 3a. Plants with hyaline or shorter arista, leaf cells spindle shaped or rhomboidal, broader 3. ...*Brachymenium*
- 3b. Plants with hyaline or shorter arista, leaf cells spindle shaped or rhomboidal, narrower 4. ...*Bryum*

#### 1. *Pohlia flexuosa* Hook. in Icon. Pl. Rar., 1: 19 (1836). (Fig. 1).

Plants terrestrial, in lax tufts, yellowish green. Stem erect, up to 8 mm long, with subfloral innovations. Leaves loosely arranged below, dense at apex; erectopatent, lanceolate up to 1.4 mm and 0.4 mm broad. Leaf margin flat, slight dentitions at apex. Costa strong, brownish, percurrent. Leaf cells in the upper region thick walled, rhomboid,  $\pm 40 \times 8 \mu\text{m}$  in size, basal cells rectangular to quadrate,  $\pm 36 \times 8 \mu\text{m}$ . Sporophyte not seen.

*Specimen examined* : India, Madhya Pradesh, Pachmarhi : Tamia Valley, growing on soil over rock, alt. c.1000 m, 10.10.1992, V. Nath & A. K. Asthana 205486.

#### 2. *Anomobryum auratum* (Mitt.) Jaeg. in Ber. Tsitigk. St. Gallischen Naturwiss. Ges., 1873 – 74: 142 (1875). (Fig. 2).

Plants terrestrial, julaceous, tufted, yellowish green, bounded by rhizoids at base. Stem upto 1.2 cm long, branched by 2 to 3 subfloral innovations, densely covered by leaves. Leaves closely appressed to the stem, ovate – elliptical with obtusely apiculate to rounded tip  $\pm 1.2 \times 0.6 \text{ mm}$  in size. Costa pale, ending much below the leaf apex. Leaf cells thick walled, linear up to  $48 \times 6 \mu\text{m}$  at apex; basal cells rhomboidal to sub-rectangular up to  $40 \times 16 \mu\text{m}$ . Sporophyte not seen.

*Specimens examined* : India, Madhya Pradesh, Pachmarhi: on way to Dhoopgarh, growing on soil, alt. c.1056 m 16.12.1993, V. Nath & A.K. Asthana 205556; On Pandav Caves, growing on rock, alt. c.820 m, 1.12.2006, V. Sahu & V. Awasthi 227685C.

#### Key to the species of Genus *Brachymenium*

- 1a. Plants smaller (up to 6 mm), pale- yellowish, leaves small, margin entire ... *B. acuminatum*
- 1b. Plants longer (up to 10 mm), glossy green, branched, leaves larger, margin dentate ... *B. ptychothecium*

#### 3. *Brachymenium acuminatum* Harv. in Hook. in Icon. Pl. Rar, 1:19 (1863). (Fig. 3).

Plants terrestrial, pale to yellowish green plants in dense mats. Stem erect, up to 6 mm high, branched by several subfloral innovations, matted by tomenta. Leaves erect, ovate – lanceolate up to 1.2 mm long and

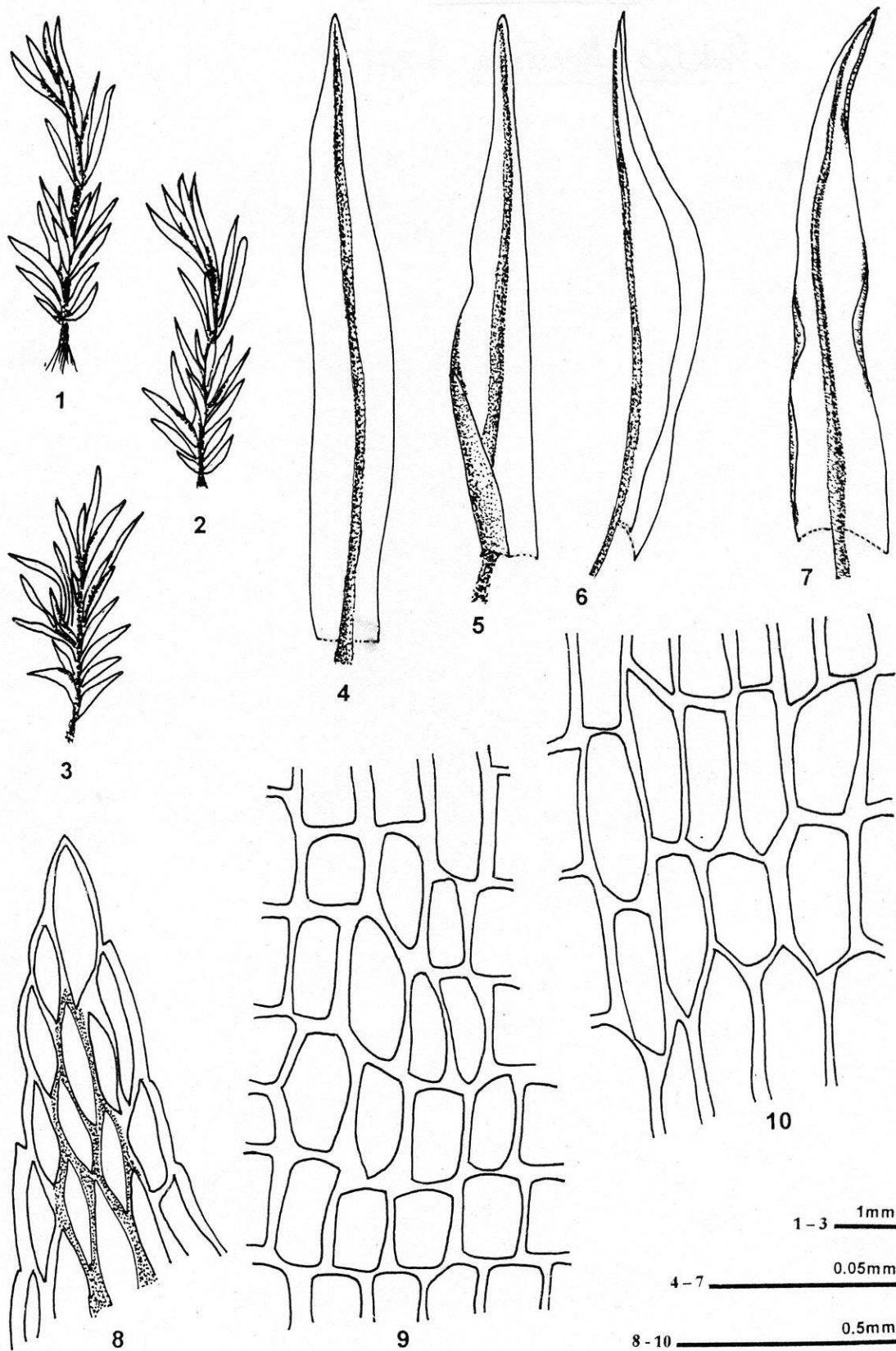


Fig. 1 (1-10) : *Pohlia flexuosa* Hook. 1-3. vegetative plants, 4-7. leaves, 8. apical leaf cells  
9. middle leaf cells, 10. basal leaf cells.

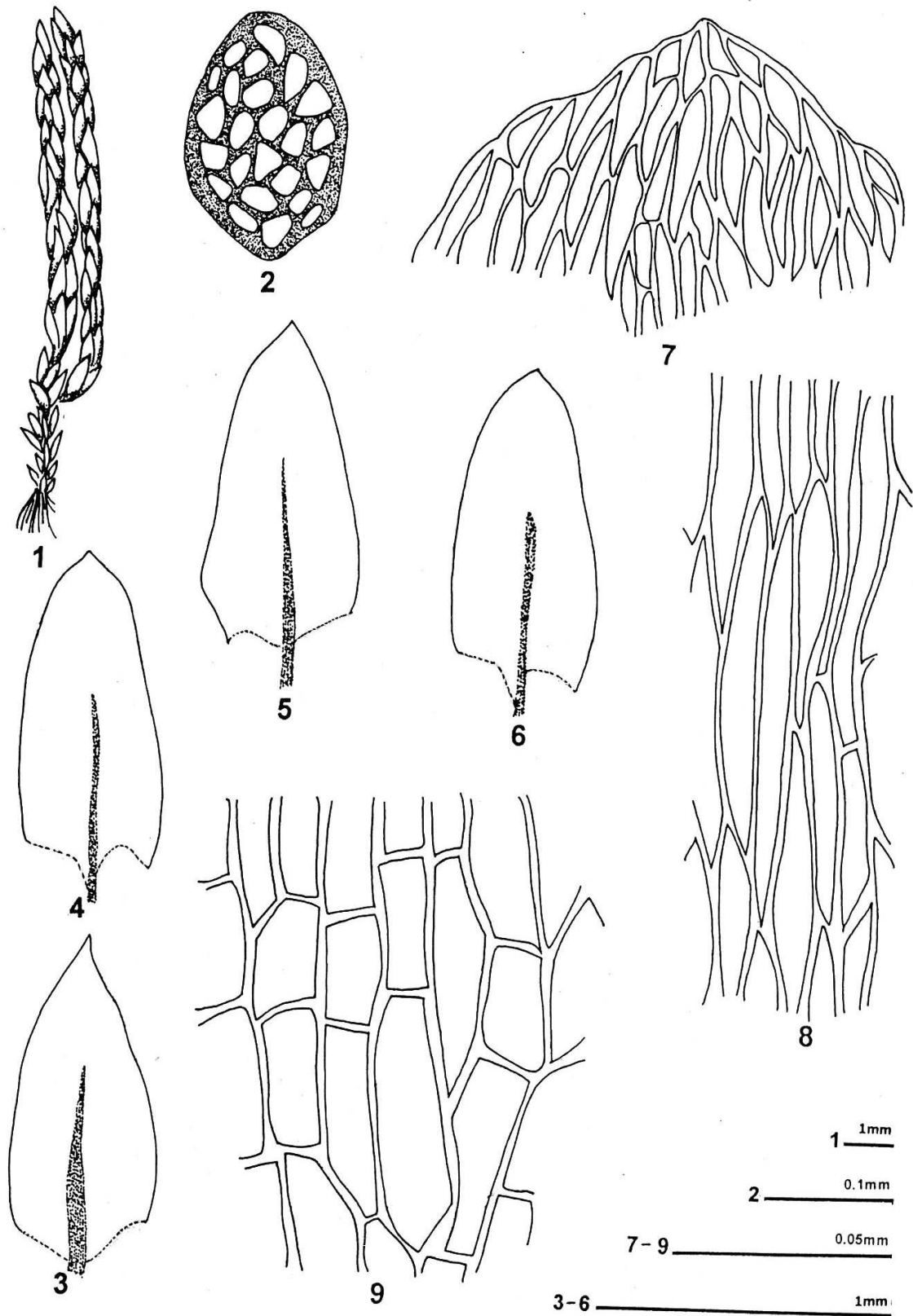
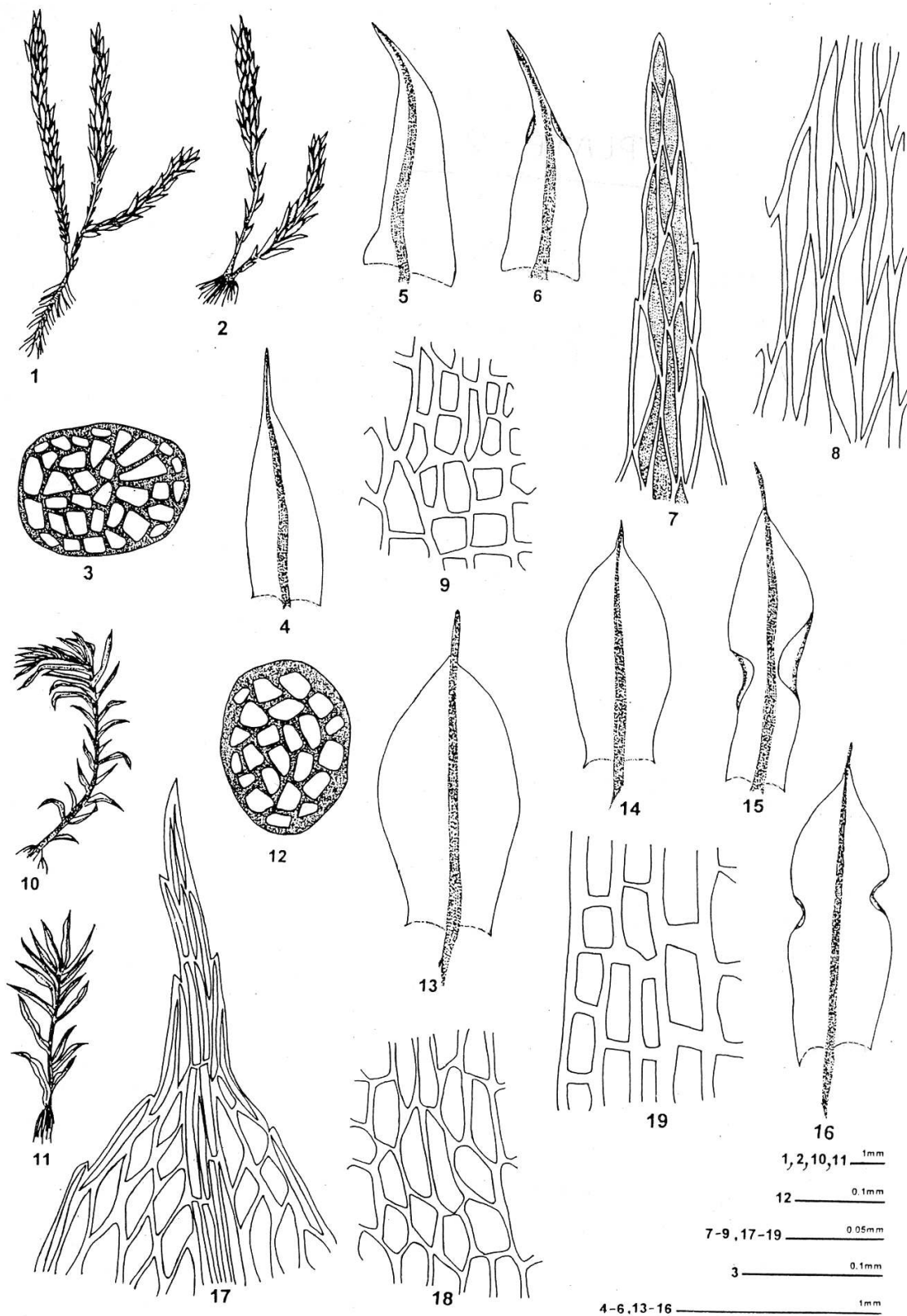


Fig. 2 (1-9) : *Anomobryum auratum* (Mitt.) Jaeg. 1. vegetative plant, 2. T.S. of stem, 3-6. leaves, 7. apical leaf cells, 8. middle leaf cells, 9. basal leaf cells.



**Fig. 3.(1-19):** *Brachymenium acuminatum* Harv. 1,2. vegetative plant, 3. T.S. of axis, 4-6. leaves, 7. apical leaf cells  
 8. middle leaf cells, 9. basal leaf cells. Figures 10-19 *Brachymenium pychothecium* (Besch.) Ochi.  
 10,11. vegetative plants, 12. T.S. of stem, 13-16. leaves, 17. apical leaf cells  
 18. middle leaf cells, 19. basal leaf cells.

0.42 mm wide, acuminate, margin entire. Costa strong, excurrent in an arista  $\pm 0.11$  mm long. Leaf cells rhomboid, up to  $75 \times 12$   $\mu\text{m}$  at apex, gradually getting rectangular at base,  $50 \times 16$   $\mu\text{m}$  in size; marginal cells narrower but no distinct margin seen. Sporophyte not seen.

*Specimens examined* : India, Madhya Pradesh, Pachmarhi : Jambu Dweep, growing on soil over rock, alt. c.900 m, 17.12.1993, V. Nath & A.K. Asthana 205598; 205599.

#### 4. *Brachymerium ptychothecium* (Besch.) Ochi in Adv.Front. Pl. Sc., 4: 108 (1963).

Plants terrestrial, tufted, glossy, green, reddish at base. Shoot erect, up to 10 mm high, with subfloral innovations. Leaves erectopate, curled when dry, oblong – spatulate, bordered and apiculate,  $\pm 1.93$  mm long and  $\pm 65$  mm broad at middle. Leaf margin entire below, slightly dentate at apex, usually revolute from base to mid leaf. Costa strong, deep brownish, excurrent in a slightly denticulate arista,  $\pm 0.27$  mm in size. Leaf cells rhomboid to hexagonal at apex,  $\pm 37.5$   $\mu\text{m}$  long and  $\pm 17.7$   $\mu\text{m}$  wide; basal cells subrectangular,  $\pm 41.7 \times 19.8$   $\mu\text{m}$ ; marginal cells elongated, narrow, forming a border of 2 – 3 rows. Sporophyte not seen.

*Specimen examined* : India, Madhya Pradesh, Pachmarhi : Down Fall, growing on moist rock, alt. c.884 m, 28.11.2006, V. Sahu & V. Awasthi 227601.

#### *Key to the species of Genus Bryum*

- |     |  |                               |
|-----|--|-------------------------------|
| 1a. | Plants glossy green with silvery tinge, leaf apex hyaline, branches julaceous  | ... <i>Bryum argenteum</i>    |
| 1b. | Plants green without silvery appearance, leaf apex not hyaline, branches non- julaceous  | ...2                          |
| 2a. | Smaller leaves ( $\pm 2 \times 0.5$ mm in size), appressed to stem, characteristic pendulous capsule                                 | ... <i>Bryum coronatum</i>    |
| 2b. | Larger leaves ( $\pm 4 \times 2$ mm in size), erectopate, capsule non- pendulous   | ... 3                         |
| 3a. | Leaf margin recurved at places, distinct border formed by normal or tinted cells   | ... <i>Bryum capillare</i>    |
| 3b. | Leaf margin revolute, marginal cells slender forming an indistinct border  | ...4                          |
| 4a. | Plants larger (up to 10 mm), leaves distant below, densely arranged above but not in comal tufts, leaf tips show mild denticulations | ... <i>Bryum paradoxum</i>    |
| 4b. | Plants smaller (up to 7 mm), leaves at apical region form comal tufts, margin entire with no denticulations                          | ... <i>Bryum caespiticium</i> |

#### 5. *Bryum argenteum* Hedw. in Sp Musc. : 181 (1801). (Fig. 4).

Plants terrestrial, small, tufted. Stems erect, short with subfloral julaceous branches which may be up to 15 mm in height; silvery white in colour. Leaves uniformly arranged on stem, ovate, concave, acuminate. Leaf size  $0.8$  to  $1.1 \times \pm 0.4$  mm, entire. Costa percurrent in some leaves, in others ending in a hyaline arista. Leaf cells rhomboidal above,  $\pm 54 \times 12$   $\mu\text{m}$  and rectangular up to  $40 \times 12$   $\mu\text{m}$  at base. Sporophyte not seen.

*Specimen examined* : India, Madhya Pradesh, Pachmarhi : Near Pandav Caves, growing on soil, alt. c. 820 m, 1.12.2006, V. Sahu & V. Awasthi 227688A.

#### 6. *Bryum caespiticium* L. ex Hedw. in Sp. Musc. : 180 (1801).

Plants terrestrial, up to 7 mm long with subfloral innovations. Leaves small, forming comal tufts only on main shoots, erect to erectopate, acuminate up to 1.5 mm long and 0.42 mm broad; margin revolute all along the length, entire. Costa excurrent in arista up to 0.18 mm long. Leaf cells rhomboidal, up to  $52 \times 12.5$   $\mu\text{m}$  at apex, becoming sub – rectangular at base, up to 75  $\mu\text{m}$  long and 20.8  $\mu\text{m}$  broad. Marginal cells narrower and longer but generally distinct border not seen. Sporophyte not seen.

*Specimen examined* : India, Madhya Pradesh, Pachmarhi : On way to Chota Mahadev, growing on soil covered rock, alt. c.854 m, 29.11.2006, V. Sahu & V. Awasthi 227628B.

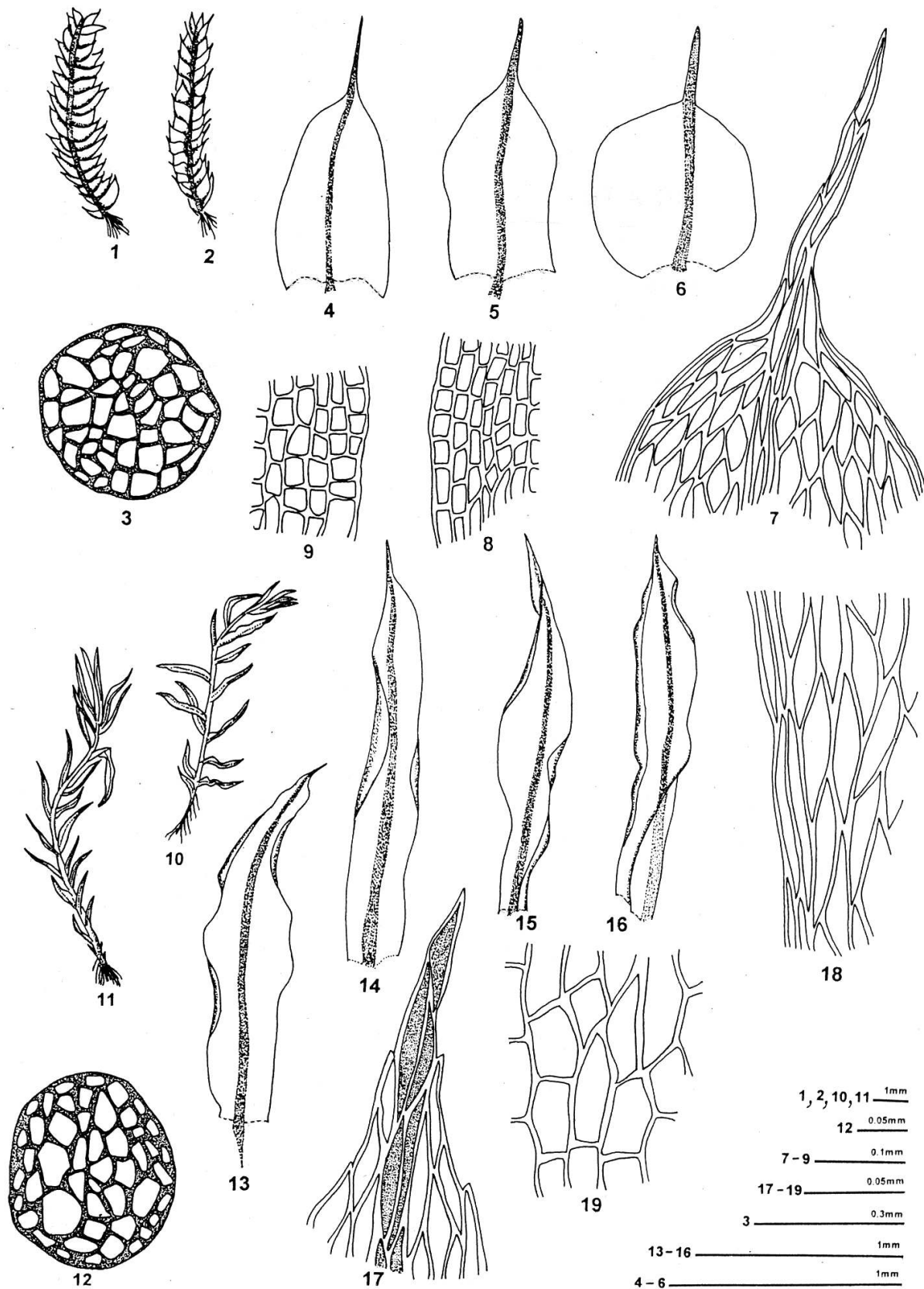


Fig. 4 (1-19): *Bryum argenteum* Hedw. 1,2. vegetative plants, 3. T. S. of axis, 4-6. leaves, 7. apical leaf cells, 8. middle leaf cells, 9. basal leaf cells, Figures 10-19 *Bryum caespiticium* L. ex Hedw. 10,11. vegetative plant, 12. T. S. of stem, 13-16. leaves, 17. apical leaf cells, 18. middle leaf cells, 19. basal leaf cells.

**7. *Bryum capillare* L. ex Hedw. in Sp. Musc.; 182 (1801). (Fig. 5).**

Plants terrestrial, up to 12 long mm, densely tufted, deep green above, reddish below, generally branched. Leaves lax in lower region, dense in upper regions. Comal tufts seen. Leaves erectopatent, ovate, acuminate, up to 4.25 mm long and 1.8 mm wide; margin entire with fine dentitions at tip. Costa stout, excurrent in an arista up to 1.9 mm long. Leaf cells thin walled; rhomboid – hexagonal up to  $60.5 \times 11.5 \mu\text{m}$  at top, rectangular up to  $67 \times 21 \mu\text{m}$  at base. Marginal leaf cells narrow, elongated forming border. Seta apical, erect but curved at tip, up to 2.5 cm long, deep red in colour. Capsule horizontal, ovate, cylindrical, with a wide mouth,  $\pm 3$  mm long and 1 mm in diameter. Peristome normal; outer teeth reddish at base, paler at tips, endostome hyaline with segments as high as outer teeth. Spores not seen.

*Specimens examined* : India, Madhya Pradesh, Pachmarhi: Down Fall, growing on soil covered rock, alt. c.1056 m, 15.12.1993, V. Nath & A.K. Asthana 205546; Jalgali, growing on soil covered rock, alt. c.900 m, 16.12.1993, V. Nath & A.K. Asthana 205577; Little Fall, growing on wet rock; alt. c.884 m, 28.11.2006, V. Sahu & V. Awasthi 229392; Near Jambu Dweep, growing on rock, alt. c.790 m, 29.11.2006, V. Sahu & V. Awasthi 227646, 227655A.

**8. *Bryum coronatum* Schwaegr. in Sp. Musc. Frond. Suppl. 1(2): 103 (1816). (Fig. 6).**

Plants terrestrial, tufted, slender, bright to dull green, tomentose at base. Stem usually branched, up to 15 mm high. Lower leaves smaller, upper ones larger, oblong – ovate, acuminate,  $\pm 2$  mm long and 0.5 mm wide. Margin entire, flat, costa reddish at base, excurrent in a arista which shows mild dentitions. Upper leaf cells thin walled, narrow, rhomboid,  $\pm 48 \times 6.5 \mu\text{m}$ ; basal cells shorter, rectangular,  $\pm 40 \times 16 \mu\text{m}$ , border cells not differentiated. Perichaetial leaves shorter, triangular. Seta apical, erect, curved at tip, reddish brown, up to 28 mm long. Capsule pendulous, thick,  $\pm 2.5$  mm long and 1 mm in diameter; capsule mouth wide, peristome reddish, outer teeth broad with sharp, hyaline, papillose tips; endostome transparent – yellowish, as high as exostome, with 2 – 3 appendiculate cilia. Spores not seen.

*Specimens examined* : India, Madhya Pradesh, Pachmarhi : Near Pandav Caves, growing on soil alt. ca 820 m, 1.12.2006, V. Sahu & V. Awasthi 227688B; On Pandav Caves, growing on rock, alt. c.820 m, 1.12.2006, V. Sahu & V. Awasthi 227681C, 227684.

**9. *Bryum paradoxum* var. *reflexifolium* (Ochi) Ochi in Hikobia, 5: 158 (1969). (Fig. 7).**

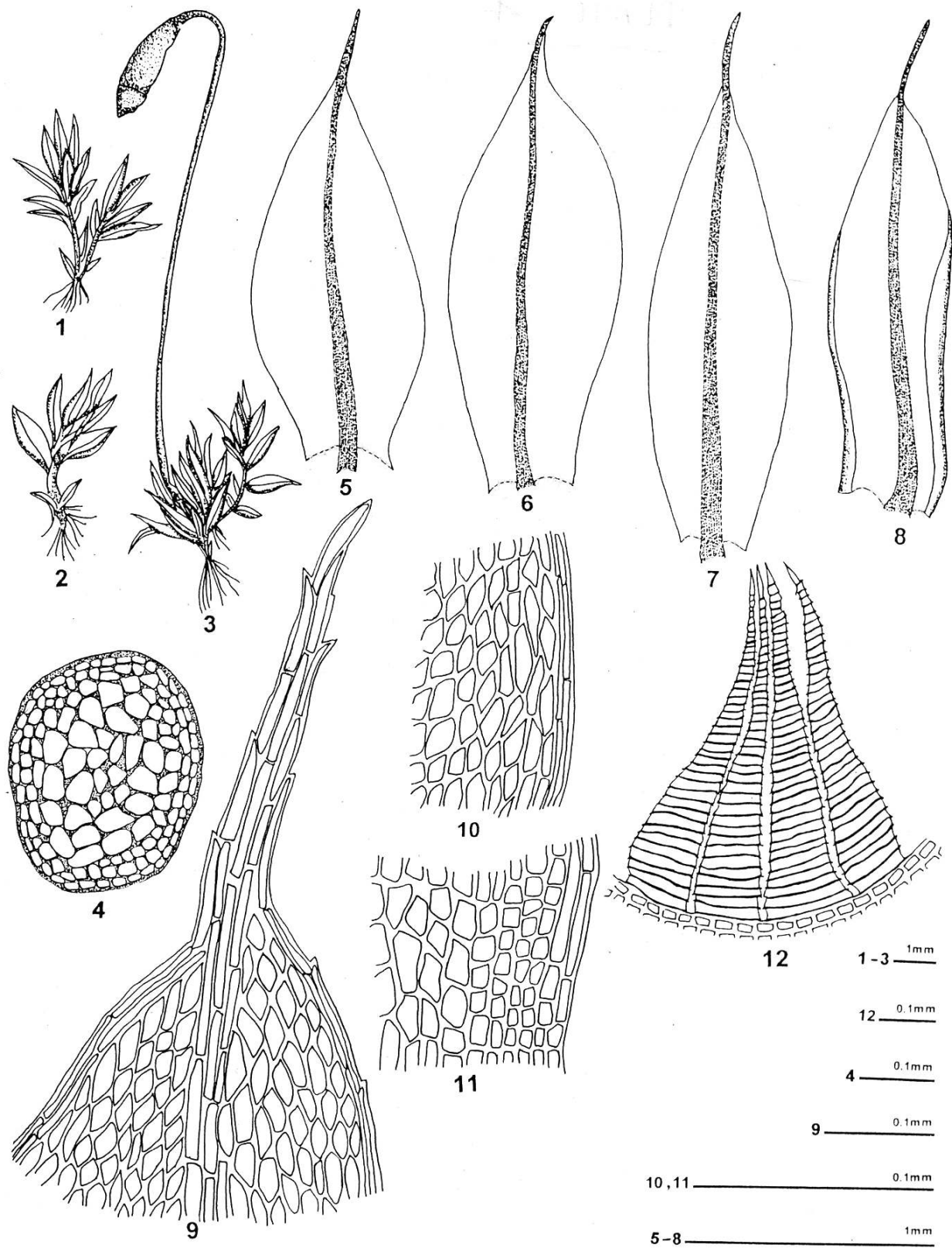
Plants terrestrial, tufted, matted with radicles below, green. Stems about 10 mm high, with subfloral innovations. Leaves smaller and distant below, larger and closer above, erectopatent, oblong – lanceolate, acuminate,  $\pm 4.4$  mm long and  $\pm 1.5$  mm wide; margin usually revolute all along, entire except showing mild denticulations at tip. Costa strong, excurrent in an arista, up to 0.16 mm long. Leaf cells thin walled; rhomboid to hexagonal at apex up to  $69 \times 17 \mu\text{m}$  in size, becoming narrower at margin, forming indistinct border; basal cells rectangular,  $92 \times 28 \mu\text{m}$  in size. Sporophyte not seen.

*Specimen examined* : India, Madhya Pradesh, Pachmarhi : On way to Bee Fall, growing on wet rocks, alt. c.820 m, 30.11.2006, V. Sahu & V. Awasthi 227666B.

## DISCUSSION

The distribution of the mosses undertaken in the present study, among the major bryogeographical zones of India has been provided in *Table-I*. Bryaceae has emerged as one of the most dominant acrocarpous moss family at PBR, as indicated by the presence of 9 taxa in the region. Although, the mosses show abundant occurrence at the PBR, yet the frequency of occurrence of any single taxon is not much. The genus *Bryum* showed good representation with 5 species. Among these, *B. capillare* emerged to be the most widely distributed moss with presence at about 4 localities and seems to exhibit some variations in its characters such as habit which is characterized mostly by comal tufts at the apical region, but may be devoid of it in a few specimens. Further, the leaf size may range from 2.5 to 4.25 mm in length and 1.3 to 1.8 mm in width. Subsequently, the leaf cell size also varies with the cells at the apical region of leaf being up to  $60.5 \times 11.5 \mu\text{m}$  in size and those of the basal region being up to  $67 \times 21 \mu\text{m}$  in size. The basal leaf cells may have a reddish tint in some cases, but not always so. The other plants studied, exhibit slight variations in characters which are not significant. In PBR, the taxa of this family were found on diverse type of terricolous habitats (*Table – II*). The distribution of





**Fig.5 (1-12) :** *Bryum capillare* L. ex Hedw. 1,2. vegetative plants, 3. plant with sporophyte, 4. T.S. of stem 5-8. leaves, 9. apical leaf cells, 10. middle leaf cells, 11. basal leaf cells, 12. Peristome teeth.

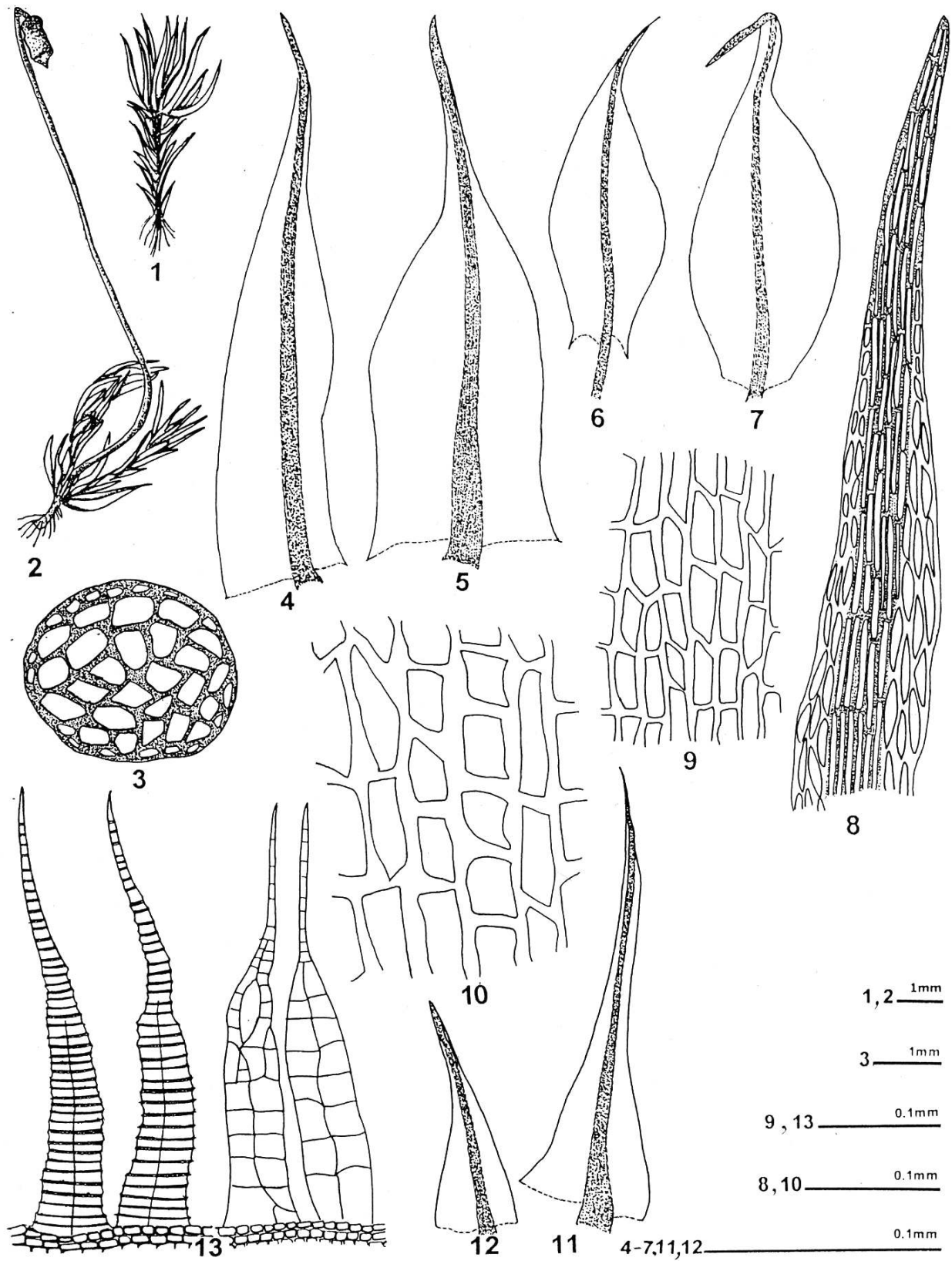


Fig. 6 (1-13) : *Bryum coronatum* Schwaegr. 1. vegetative plant, 2. plant with sporophyte, 3. T.S. of stem  
4-7. leaves, 8. apical leaf cells, 9. middle leaf cells, 10. basal leaf cells, 11, 12. perichaetial leaves  
13. peristome showing exostome and endostome teeth.

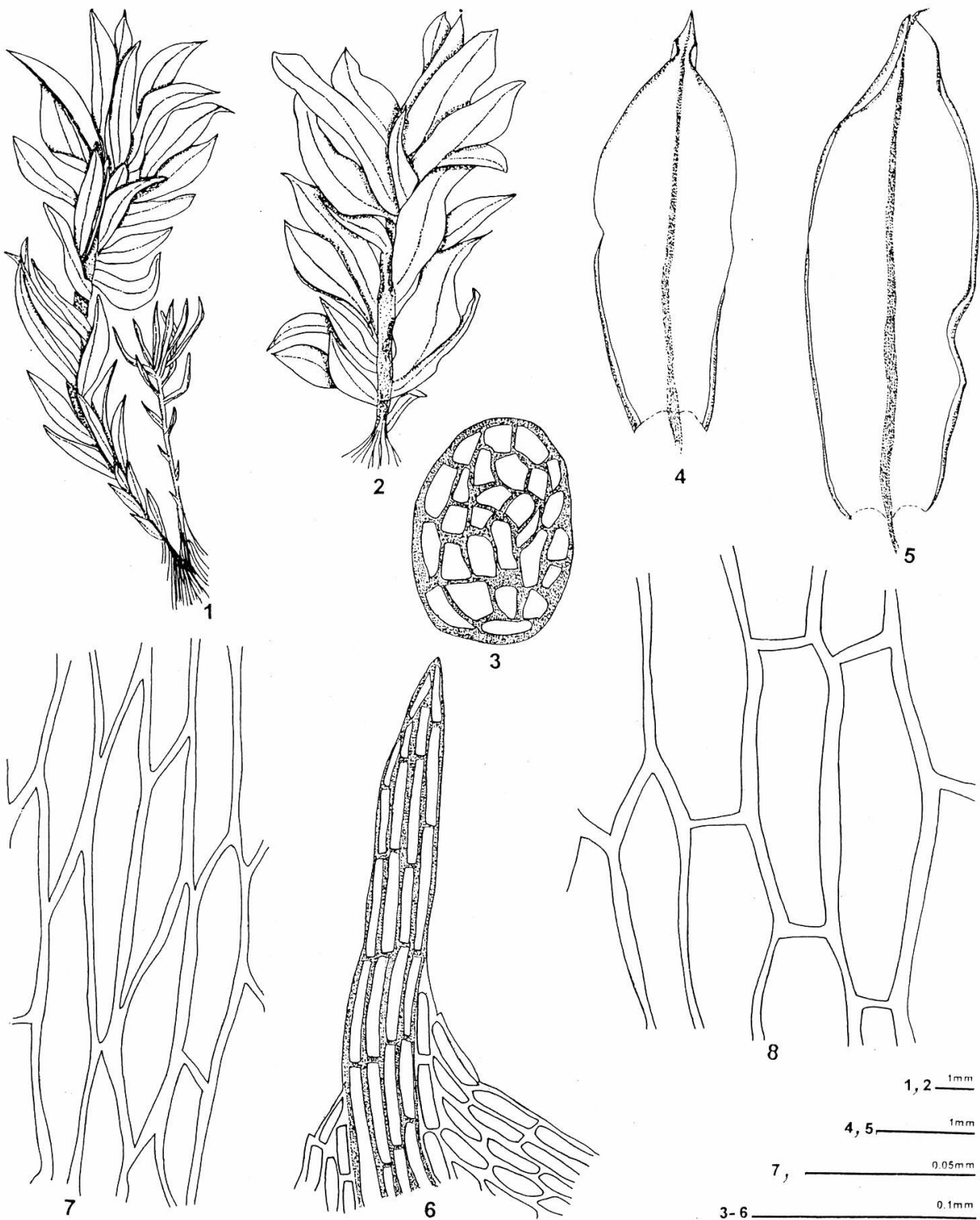


Fig. 7 (1-8) : *Bryum paradoxum* var. *reflexifolium* (Ochi) Ochi 1,2. vegetative plants, 3. T.S. of stem, 4,5. leaves 6. apical leaf cells, 7. middle leaf cells, 8. basal leaf cells.

*Table – III* : Distribution of the taxa in various localities of Pachmarhi Biosphere Reserve

these taxa collected from various localities is listed in *Table – III*. An account of distinctly recognized taxa of mosses has been provided from the Pachmarhi Biosphere Reserve for the first time.

### ACKNOWLEDGEMENTS

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## पचमढी जीवमंडल रिजर्व ( मध्य प्रदेश ), भारत के कुल ब्राएसी ( ब्रायोप्सिडा ) का टैक्सोनोमिक मूल्यांकन

वीरेन्द्र नाथ एवं रीसा गुप्ता

### सार संक्षेप

800-1060 मीटर तुंगता के मध्य पचमढी जीवमंडल रिजर्व ( पी.बी.आर. ) के विभिन्न प्राकृतवास में उगने वाले ब्राएसी के नौ टैक्सा : एनोमोब्रियम ऑरेंटम, ब्रेकिमेनियम एक्जुमिनेटम, ब्रेकिमेनियम टाइकोथेसियम, ब्रायम अर्जेणशियम, ब्रायम सेस्पिटिसियम, ब्रायम केपिलेयर, ब्रायम कोरोनेटम, ब्रायम पेरेडोक्सम प्रभेद रिफ्लोक्सिफोलियम एवं पोहलिया फ्लेक्जुओसा के मूल्यांकन किए गए। इन काई का पचमढी जीवमंडल रिजर्व से पहली बार रिपोर्ट हो रहा है।

## OBSERVATIONS ON THE MORPHOLOGY OF *PORPHYRA VIETNAMENSIS* TANAKA & P.H. HO (BANGIALES, RHODOPHYTA) AT VISAKHAPATNAM COAST, INDIA

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### ABSTRACT

*Porphyra vietnamensis* Tanaka & P.H. Ho was collected from the east coast (various parts of Visakhapatnam) of India during a low tide status. Detailed morphology of the taxon was studied. The present specimens are smaller than the type material originally described but slightly bigger than the material described from Visakhapatnam coast.

**Keywords :** *Porphyra vietnamensis*, morphology, Visakhapatnam coast, India.

### INTRODUCTION

*Porphyra vietnamensis* Tanaka & P.H. Ho (Bangiales, Rhodophyta) is an edible red alga (Subha Rao & al. 2007) first described from Viet-Nam (Tanaka & Pham-Hoang Ho, 1962). The particular species of interest is not so frequently found [Viet-Nam (Tanaka & Ho 1962, Ho 1969, Tsutsui & al. 2005)]; Hawaiian Islands (Abbott 1999, McDermid & al. 2005); China (Tseng, 1984); Pakistan (Silva & al. 1996)]. Børgesen (1937) reported *P. vietnamensis* as *P. tenera* Kjellman from harbour area of Madras. Sreeramulu (1952) defined the plants as *P. naidum* Anderson from Visakhapatnam (Waltair) coast. Ultimately it was confirmed as *P. vietnamensis* by Unameheswara Rao & Sreeramulu (1963). They collected the same specimens from the Visakhapatnam coast in the year 1964 and 1970. Subsequently various other workers also reported this taxon from the west coast, especially from the coastal area of Goa, [Dhargalkar & al. (1981), Sahoo & al. (2006)]. According to Sahoo & al. (2001) *Porphyra vietnamensis* is the most abundant among the all other *Porphyra* species reported from India. During an algal excursion to Visakhapatnam coast the authors recorded the above mentioned taxon and studied its detailed morphology.

### MATERIALS AND METHODS

Algal specimens were collected from intertidal zone of various localities of Visakhapatnam coast (Collection No.V-14, V-33, V-38, and V-105) during a low tide state. Field photographs with proper measurements were made by Nikon SLR camera. The collected samples were preserved in 5% formalin solution made with marine water. The collected materials were kept in plastic bags and also in hard plastic transparent containers with detailed field notes. The thalli were observed under a stereo binocular microscope. Digital photographs by Leica DMLB system were made from preserved specimens. Identifications were made following Desikachary & al. (1990). The collected preserved materials along with the slide preparations are stored in Phycology laboratory, The University of Burdwan for future study and reference purpose.

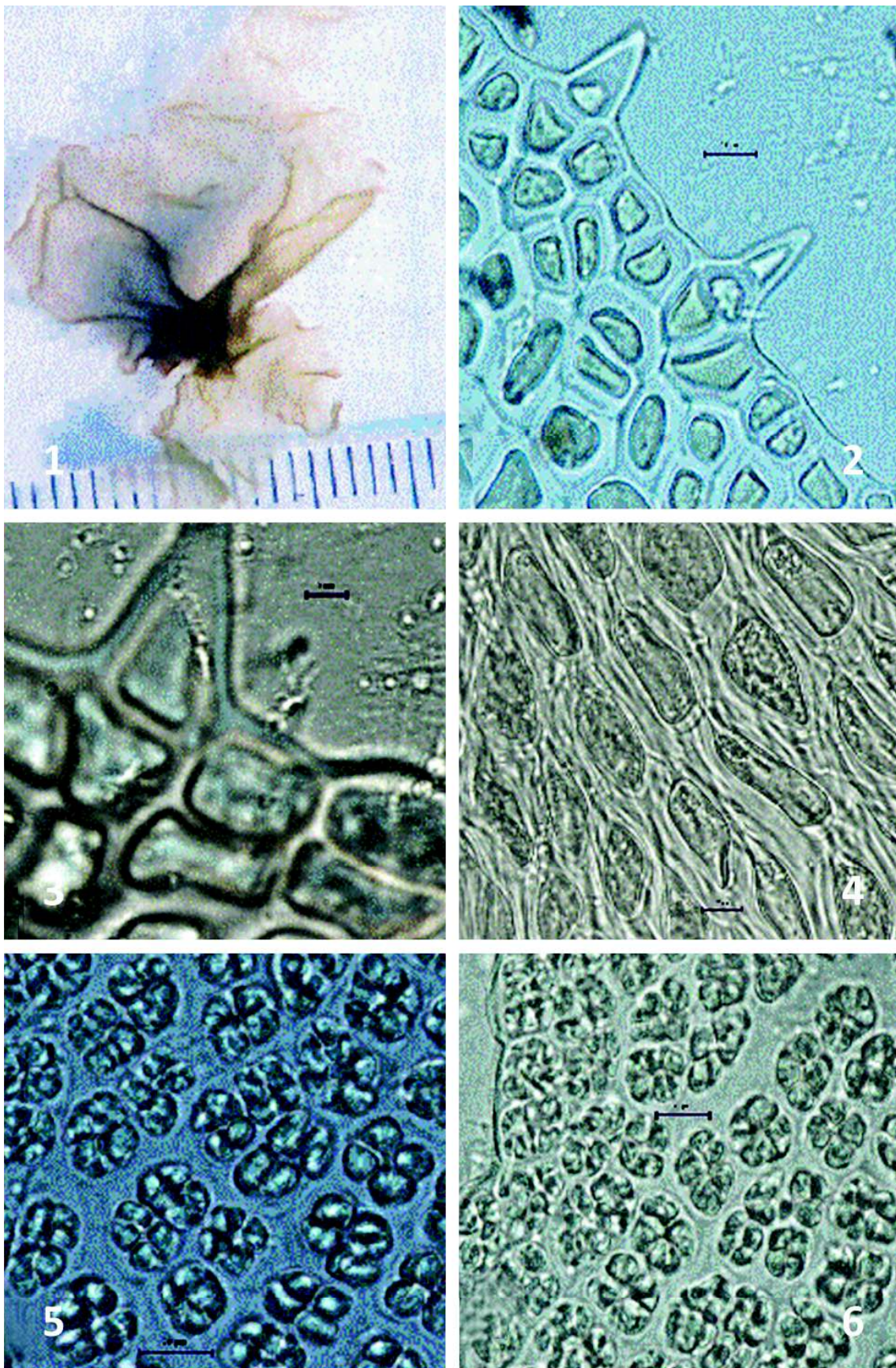
### RESULTS AND DISCUSSION

***Porphyra vietnamensis* Tanaka & P.H. Ho.**

(Tanaka & Ho 1962, p.34, f.10-11; Desikachary & al. 1990, p.36, pl.2, f.4)

The plants are membranous, attached to the rocky substratum with the help of slightly circular disc shaped holdfast like attachment organ. The specimens are mostly found along with some other algae like *Enteromorpha flexuosa*, *E. intestinalis*, and *Chaetomorpha aerea*. Sometimes tiny filaments of *Lyngbya cinerescens* were found lodged on the marginal part of the specimen.





**Fig. 1-6.** *Porphyra vietnamensis* Tanaka & P.H. Ho: Thallus morphology: 1. Mature thallus  
 2. Thallus margin showing spines; 3. Enlarged view of marginal spines;  
 4. Pear shaped cells at the basal part of the thallus and 5 & 6. Part of cystocarpic thallus in surface view.



The plant species of interest is monostromatic, 1.8-3.2 cm in length and 0.7-1.5 cm broad; monoecious, prominent male gametangial portions along with zygotosporangial patches appear on the same thallus; reproductive patches are observed along the marginal sides. Vegetative and reproductive portions are of almost same thickness; margin wavy and serrated with spinous projections, The tip portions of the spinous projections are slightly pointed to obtuse rounded in nature; vegetative cells in surface view 9.2-11.3  $\mu\text{m}$  in length and 4.5-8.5  $\mu\text{m}$  in breadth; there is a mucilage layer which is 4-5.2  $\mu\text{m}$  thick; each cell is slightly globular to angular in shape, with a single chromatophore, somewhat stellate and covers the whole cell partly; carpogonia are of pinkish patches found in marginal as well as apical part and spermatangia showing its identity as slightly pale patched region at the marginal side; here 64 spermatia arranged in four tiers of four each in a spermatangium and the number of carpospores within a carposporangium is eight; the thallus expanding above into soft blade of varying degrees with carpogonium simple with long trichogyne formed by vegetative cells; carpogonium 19.5-33.7  $\mu\text{m}$  in length and 9.6-11.63  $\mu\text{m}$  in breadth, trichogyne 0.4-1.1  $\mu\text{m}$  in thickness, carpogonia are found on marginal to slight inward portions of the thallus.

After comparing with descriptions provided by Tanaka & Ho (1962) for the type species it is concluded that the observed specimens are smaller than the type material but slightly bigger than the specimens described by Umamaheswara Rao & Sreeramulu (1964) from Vishakhapatnam coast.

#### ACKNOWLEDGEMENTS

The authors are thankful to the Head of the Department of Botany, The University of Burdwan for providing laboratory facilities, to G. Mustafa and Prof. Pranjit Sarma for their support and encouragement in various stages of this work and to Goutam Bala and C. Prakasam for their constant help in various occasions.

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## विशाखापतनम सागर तट, भारत में पोर्फिरिया विएतनेमेंसिस तनाका एवं फाम-होआंग हो ( बेंगिएल्स, रोडोफाइटा ) की आकारिकी पर प्रेक्षण

शुभव्रत घोष एवं जय प्रकाश केशरी

### सार संक्षेप

ऊँचे ज्वार की स्थिति में भारत के पूर्वी सागर तट (विशाखापतनम के विभिन्न भागों से पोर्फिरिया विएतनेमेंसिस तनाका एट फाम-होआंग हो का संग्रह किया गया। टैक्सोन की आकारिकी का विस्तृत अध्ययन किया गया। वर्णन किए गए मूल प्ररूप सामग्री से वर्तमान नमूने छोटे हैं लेकिन विशाखापतनम सागर तट से वर्णित सामग्री से कुछ बड़े हैं।

## TWO MOSSES NEW TO THE BRYOFLORE OF THE INDIAN MAINLAND

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### ABSTRACT

Two mosses, viz., *Calymperes moluccense* and *C. taitense*, earlier known to occur only in the Andamans in India, are recorded for the Indian mainland. They are described in detail and illustrated.

**Keywords :** Andamans, New Records, Mainland India, *Calymperes moluccense*, *Calymperes taitense*.

### INTRODUCTION

Since the lower groups of plants are continued to be neglected in India, studies on the bryoflora of the Southern Western Ghats were initiated in the Tirunelveli-Travancore hills about a decade ago with a view to consolidating the flora and the important findings are published as and when found. In an earlier contribution 4 mosses, viz., *Calymperes motleyi*, *Fissidens robinsonii*, *Leucophanes glaucescens* and *L. nicobaricum* were recorded for the Indian mainland (Daniels & Daniel, 2005). In the present contribution two mosses, viz., *Calymperes moluccense* Schwägr. and *C. taitense* (Sull.) Mitt., earlier known to be distributed only in the Andaman & Nicobar Islands in India, are added here to the bryoflora of the Indian mainland. Each species is provided with the correct name, basionym/synonyms, if any, a detailed description, notes on habitat and distribution and an illustration. Specimens cited are at SCCN (Herbarium, Botany Department, Scott Christian College, Nagercoil).

1. ***Calymperes moluccense*** Schwägr., Sp. Musc. Frond. Suppl. 2: 99. 1824; Bruehl, Rec. Bot. Surv. India 13(1): 33. 1931; L.T. Ellis, J. Bryol. 15: 705. 1989. - Type: Moluccas, Rawack, *Gaudichaud* 29(15) (Isotypes - BM). *C. kurzianum* Hampe ex Müll.Hal., Flora 61: 82. 1878; Bruehl, Rec. Bot. Surv. India 13(1): 32. 1931; Gangulee, Moss. E. India. 1(3): 598. 1972; Lal, Checklist Indian Moss.: 35. 2005. - Type: South Andaman Isl., *S. Kurz* 1665 (BM). *C. contractum* Besch., Ann. Sci. Nat., Bot. 8, 1: 264, 280. 1985. - Type: Sri Lanka, *Thwaites* 62 (BM). (**Fig. 1**).

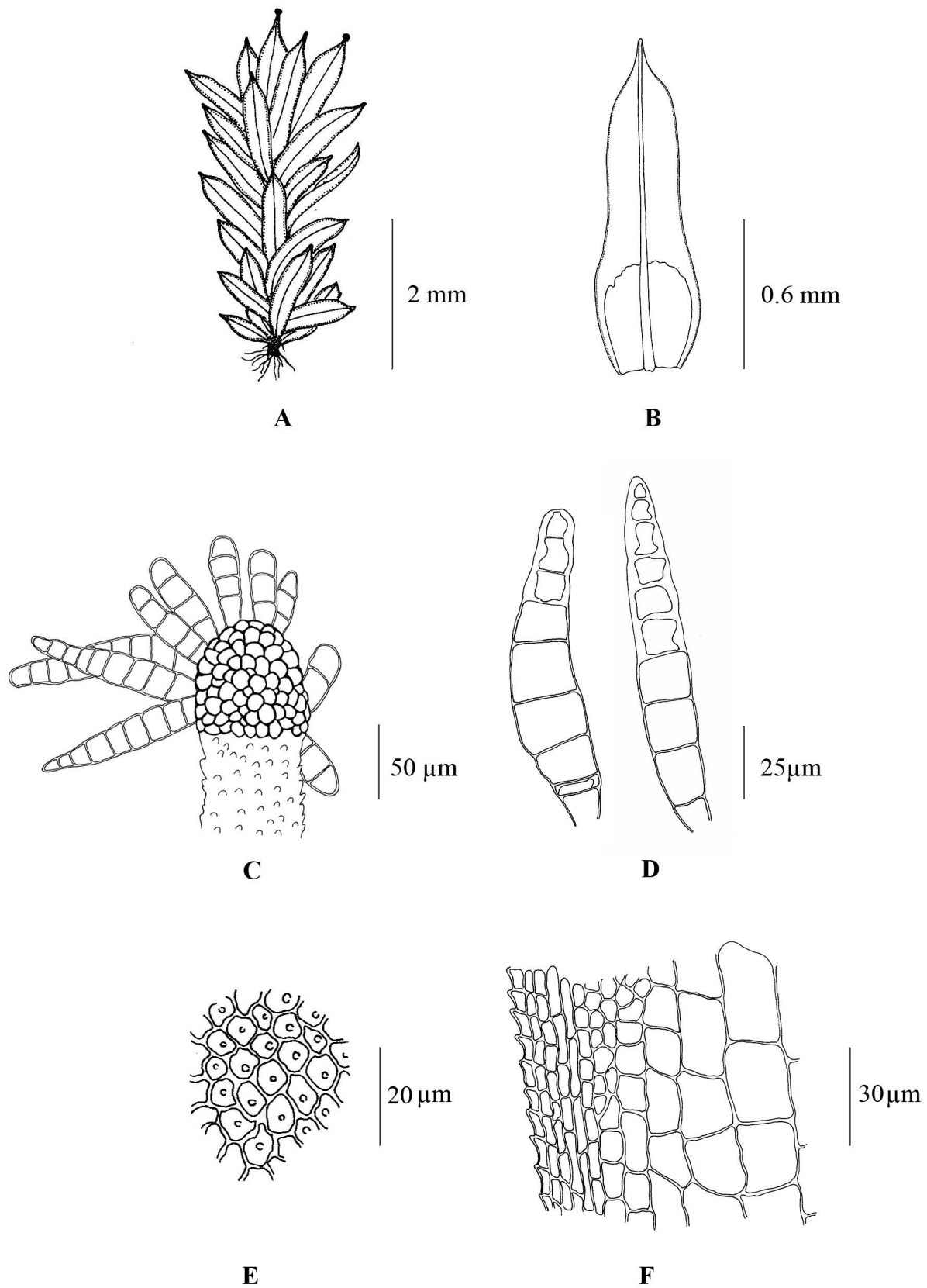
Plants 4 - 6 mm high, caespitose or forming mats, pale green. Leaves curled and falcate when dry, erectopate to spreading when wet, ovate-lingulate, cuneate at base, 1.5 - 3 × 0.4 - 0.6 mm, dimorphic; nongemmiferous ones obovate to lingulate, acute; margin entire at tip, faintly toothed at base; cells hexagonal to quadrate, 1-papillate; apical and median cells 4 - 8 × 4 - 8 µm; basal ones at margin 16 - 32 × 4 - 8 µm; those of cancellina 9- or 10-rowed on either side of costa, 20 - 40 × 16 - 40 µm, transparent, elongate, rectangular, smooth; teniola, submarginal, 2- or 3-rowed, extending to a little below apex; costa excurrent. Gemmae 120 - 200 × 24 - 40 µm, green, radiating and clustered at costal apex. Sporophyte not seen.

*Habitat:* Corticolous, in riparian forests, c. 500 m.

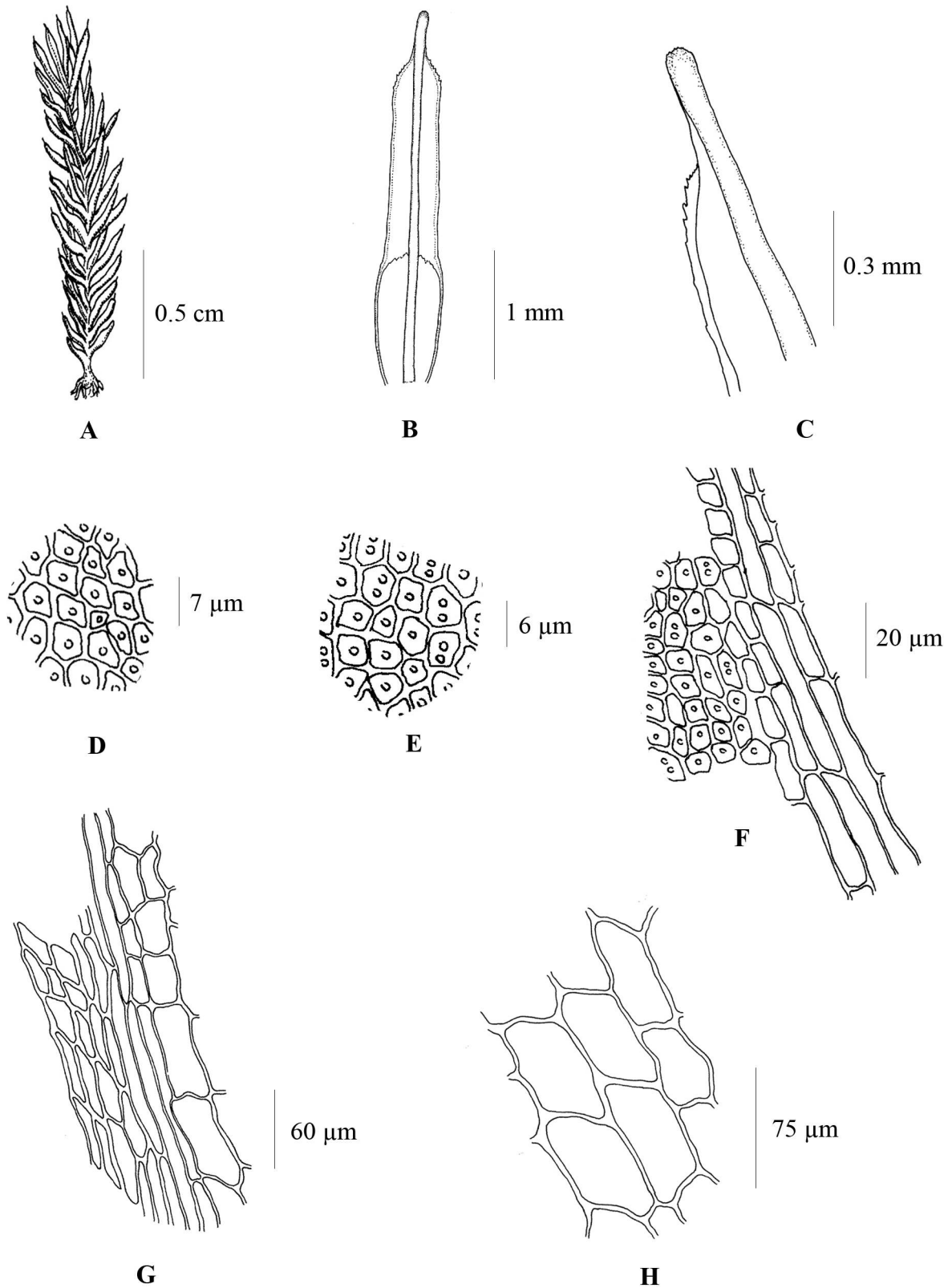
*Distribution :* Indonesia (Moluccas), Sri Lanka and India: Andaman & Nicobars and Tamil Nadu (W. Ghats of Kanyakumari dist.).

*Specimen examined :* Tamil Nadu, Kanyakumari dist., W. Ghats, Lower Kodaiyar, c. 500 m, 22.01. 2009, A.E.D. Daniels & J.L. Mabel 106.

2. ***Calymperes taitense*** (Sull.) Mitt., J. Linn. Soc. Bot. 10: 172. 1868; L.T. Ellis, J. Bryol. 15: 718. 1989. *Syrrhopodon taitense* Sull., U.S. Expl. Exped., Musc.: 6. 1860. - Type: Society Isl., Tahiti, 1838 - 1842, *C. Wilkes* s.n. (BM). *Calymperes andamense* Besch., Ann. Sci. Nat. Bot. 8, 1: 276. 1895; Bruehl, Rec. Bot. Surv. India 13(1): 33. 1931; Gangulee, Moss. E. India 1(2): 622. 1971; Lal, Checklist Indian Moss.: 35. 2005. - Type: South Andaman Isl., *Kurz* s.n. (BM). (**Fig. 2**).



**Fig. 1(A-F).** *Calymperes moluccense* Schwägr.: **A.** Habit; **B.** Leaf; **C.** Leaf apex with gemmae; **D.** Gemmae; **E.** Leaf median cells; **F.** Leaf basal cells with teniola and cancellina.



**Fig. 2(A-H).** *Calymperes taitense* (Sull.) Mitt.: **A.** Habit; **B.** Leaf; **C.** Leaf apex; **D.** Leaf apical cells; **E.** Leaf median cells; **F.** Median cells with teniola; **G.** Leaf basal cells with cancellina and teniola and **H.** Cancellina cells.

Plants 1 - 2 cm high, caespitose, green. Leaves closer above, lax below, erectopatent, curled when dry,  $1.5 - 2.5 \times 0.3 - 0.7 \mu\text{m}$ , ovate-lingulate, serrate at margin; cells incrassate, quadrate-rectangular - hexagonal, cells  $8 - 20 \times 6 - 16 \mu\text{m}$ , unipapillate; cancellinae cells 9 - 13-rowed, hyaline,  $16 - 32 \times 12 - 20 \mu\text{m}$ , rectangular, on either side of costa; teniola submarginal, 3- or 4-rowed, extending to a little below apex; costa excurrent, gemmiferous. Sporophyte not seen.

*Habitat* : Corticolous, in degraded evergreen forests, 200 - 550 m.

*Distribution* : South East Asia, Oceania and India: Andamans, Tamil Nadu (W. Ghats of Tirunelveli and Kanyakumari dists.) and Kerala (W. Ghats of Thiruvananthapuram dist.).

*Specimens examined* : Tamil Nadu, Kanyakumari dist., W. Ghats, Maramalai, c. 550 m, 2.10.2004, *Hepzi* 67; Perunchani, c. 260, 18.3.2004, *Catherine* 27; Kattuva, c. 200 m, 30.8.2004, *Shoba* 20. Kerala, Thiruvananthapuram dist., W. Ghats, Neyyar Wildlife Sanctuary, c. 300 m, 16.10.2007, *Brijithlal* 206; 22.12.2007, *Brijithlal* 259.

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### भारत के मुख्य भूमि के ब्रायोफ्लोरा के लिए दो नयी माँस

ए.इ.डी. डेनियल एवं जे.एल. मेबेल

#### सार संक्षेप

भारत में अंडमान में व्याप्ति की जानकारी वाली दो माँस *केलिम्पेरिस मोल्युक्सेंस* एवं *केलिम्पेरिस टेटेंसे* का भारत के मुख्य भूमि में अभिलेख हुआ है। उनके विस्तृत वर्णन तथा चित्रांकन हुए हैं।

## TAXONOMIC IMPLICATION OF CONDUCTING ELEMENTS IN THE ACROCARPOUS MOSSES

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### ABSTRACT

Present study deals with the structure and development of conducting elements in the nine orders of acrocarpous mosses. The significance of conducting tissues in mosses in relation to their habitat conditions, growth forms and leaf cell patterns has been discussed. Features of cells in different portions of the stem and the laminal cell patterns and costa are taken into consideration. Although water-conducting cells are unspecialized in mosses, yet the study shows that they seem to play a vital role in the conduction and provide additional criteria for the distinction of taxa. Four categories have been determined as (i) Acrocarpous mosses with a distinct thick-walled conducting strand (6-7 layered) as hydrome which is surrounded by patches of leptoids. Cortex consists of thick walled cells (6-10 layered). Costa has stereidal cells and well developed conducting elements in leaf, example *Polytrichum* (ii) Acrocrops with thick-walled, narrow, elongated conducting strand (4-5 layered), cells angular in the cortex (6-8 layered). Leaf cells are rectangular, irregular and porous with incrassate walls, example *Dicranum* (iii) Acrocrops with conducting tissue (2-5 layered) stereidal, thick walled or thin walled varying in the course of development. Leaf cells are mutipapillate, rounded-quadrate, costa is present, examples *Hyophila*, *Philonotis* and (iv) Epiphytic pleurocarps with conducting cells rudimentary, thickened, scattered (2-4 layers) and parenchymatous, cortical cells (2-3 layered) thick walled. Leaf cells are small, rounded or linear and papillate, costa may be present or absent, example *Leucodon*. The study would constitute a formidable task, especially if intraspecific structural variability is considered. It serves a model system in the eco-physiological aspects.

**Keywords :** Ectohydric, Endohydric, External Conduction, Leaf cell pattern, Stereidal cells.

### INTRODUCTION

Majority of plants on the land are adapted to absorb and conduct water from the soil. Bryophytes adopted the alternative strategy of evolving desiccation tolerance, growing during moist period and suspending metabolism during drought. Bryophytes show remarkable challenges to the water relations. Mosses developed several strategies to absorb water and solutes including external transport, cell-to-cell transport and ability to survive desiccation which make them to occupy diverse habitats. Most bryophytes take up water and nutrients over the whole surface of shoots and leaves through external conduction (ectohydricism), though in some taxa conduction occurs through specialized internal conducting cells. This strategy of bryophytes makes up them a prominent part of vegetation. The growth forms of mosses also make them to hold water in larger quantities. The water retention capacity directly influences the productivity. Most vascular plants are Homoiohydric, i.e. transpiratory water loss is greatly restricted when the potential for evaporative water loss exceeds the rate at which water can be supplied through the xylem from the soil. Bryophytes are Poikilohydric, i.e. the rapid equilibration of the plant's water content to that of the surrounding environment and desiccation tolerant, i.e. to recover after being air-dry at the cellular level. External conduction of water by capillary action has a great significance and considered as an effective path of water supply in numerous mosses. The exact role played by external conduction depends on the morphology and anatomy of the gametophore and also on the environmental factors, mainly the relative humidity. The families Polytrichaceae and Mniaceae represent the well-developed endohydric groups (Proctor, 2000) which has stereome, leptome and a central strand. Leptome is composed of phloem like sieve cells. Hydroids and stereids make up the central strand (Zamski & Trachtenberg, 1976) and collectively called Hydrome. Endohydric taxa have well developed rhizoids or more root-like structures, able to abstract water from moist porous substrate, and have relatively water-repellent surface. Hydroids are water conducting cells that lack any horizontal connections. Stereids are elongate, thick-walled,

and slender and fiber like cells occurring in leaf costa and cortex of the stem. Pleurocarpous forms led to the movement of substances mainly in a horizontal pattern.

The present study is made on the internal structure of the leafy axis of the taxa of various taxonomic groups and the anatomical features are elucidated in relation to the adaptive strategy for water conduction, growth patterns and habitat conditions. The mosses with erect shoot axis absorb the water from the continuous capillary stream of water present along the shoots and also through the conducting cells and developed stereidal cells for mechanical support. The development of the conducting strand varies among different taxa indicating their distribution and habitat type. The present work aims at the survey of conducting elements in some of the mosses to describe organization and distribution of tissue components in the leafy axes in relation to their habitat, laminal cells and costa. As no comprehensive survey of conducting tissues in Indian mosses has yet been completed, this would constitute a formidable task, especially if intraspecific structural variability is considered. It serves a model system in the eco-physiological aspects.

### MATERIALS AND METHODS

Mosses from different habitats in the Western Himalaya were collected in polythene bags. They were air dried, and stored in labeled standard-sized (10×15 cm) paper packets. Moss samples were revived in water and regenerated in petridishes and immersed in 0.1% of Safranin solution. Transverse and longitudinal sections were cut down serially by sharp razor. Whole mount of leaves were made in Gum Chloral Mounting Medium.

### RESULTS

Significant variations are found in the distribution and the type of the conducting cells in different groups of taxa. In *Sphagnum*, no specialized conducting cells are observed (**Fig. 1A**). In *Pogonatum*, the conducting strand consists of 5-6 layers of thick walled cells and the cortex of moderately thickened cells (**Figs. 1B,C**). Members of the orders Pottiales and Bryales show a wide range of differentiation in conducting cells. In *Dicranum lorifolium* (Dicranales), outer portion of cortex has extremely thick stereidal cells (4-5 layered) followed by moderately thick walled parenchymatous cells (8-9 layers) and the central portion has thick-walled, narrow- elongated conducting cells with oblique end walls (**Fig. 1D**). *Leucobryum humillimum* shows less developed conducting strand (**Fig. 1E**) in comparison to that of *Dicranum lorifolium*. *Dicranum* grows on rocks and hard substrata that need efficient conducting system. *Leucobryum* generally grows on the tree barks or on porous substrata and gets enough moisture from the bark. A well developed conducting strand was observed in *Bryum coronatum*. It consists of a central core of small thick-walled cells in 2-3 layers surrounded by a distinct layer of elongated and pigmented endodermal cells. The cortex is made of 6-7 layers of pentagonal cells (**Figs. C, D**). In *Bryum plumosum* the central strand was observed to be less developed probably as these plants were found growing on permanently moist and wet substratum and do not require specialized conduction cells. A central core of 3-4 layers of pigmented cells is observed in *Hyophila involuta* (**Fig. 1F**). In *Plagiomnium* and *Meteorium* conducting cells are poorly developed and conduction is performed by thick walled parenchyma cells (**Figs. 2E, 3A, B**). *Brachythecium* lacks the specialized conducting cells (**Figs. 3 C,D**).

Highly developed conducting tissue is observed in those plants which were occurring on impermeable substrata or dry soil as well as on exposed sites. During dry period the available moisture in porous soil particles is absorbed by the conducting cells through rhizoids. The taxa with plagiotrophic shoots form large surface area and are able to absorb water from the air. These plants showed poorly differentiated central core of cells at different stem portions. The conducting cells in the shoots were found to be well developed in those taxa where the laminal cells were small and rounded-quadrangle. The conducting cells are poorly differentiated in the taxa where the laminal cells are wide and thin walled. The taxa with narrow laminal cells lack the differentiated conducting cells in the stem.

### DISCUSSION

Bryophytes are distinguished from tracheophytes by two important characters – (i) Bryophytes are ecologically persistent. (ii) Absence of lignin containing water-conducting xylem tissue. Despite the typical relegation of Non-Vascular category, conduction has played a major role in the phylogenetic history of mosses. In pleurocarpous mosses internal substances move horizontally (Kawai, 1991). Among acrocarpous mosses



the axis may have a leptome, a surrounding sheath, a stereome and a central hydrome which constitute a well-developed endohydric pathway. The elongated hydroids typically occur in bryophyte stems (Héban, 1970), but lack lignin and secondary wall thickenings (Taylor, 1988). Some acrocarpous mosses also show ectohydric pathway, as they absorb water rapidly into the cells by capillary systems (Buch, 1947). Water is being held in the larger capillary spaces between the moss shoots within the moss carpet and the porous cells of the leaf base (Proctor, 1979).

Héban (1974) described the conducting system in Polytrichales and the development of hydroids. The extent of this development is influenced by various parameters such as moisture substrata, climatic conditions etc. The conducting strands in mosses may be well developed, reduced or absent. The evolutionary significance of distribution patterns of water conducting tissues in mosses has been interpreted in a variety of ways. Héban (1979) opined that characteristics of conducting tissues can provide additional support to bryophyte systematics and gave three possible views regarding their evolution:

- (1) No conducting strand  $\longrightarrow$  reduced strand  $\longrightarrow$  well developed strand
- (2) Well developed strand  $\longrightarrow$  reduced strand  $\longrightarrow$  no strand
- (3) Well developed strand  $\longleftarrow$  reduced strand  $\longrightarrow$  no strand

On the basis of the present observations, the evolution of conducting cells seems to be related to a number of factors as discussed below:

(A) *Conducting tissue in relation to the distribution* : The taxa, which have a wide distribution scenario, possess a large variation in the presence of conducting tissues. The populations, which are found on higher altitudes and arid areas show well developed conducting strand, whereas the population of the same species growing in moist, temperate or tropical conditions shows poorly developed strand. *Dicranum* growing mainly on barren rocks at higher altitudes shows well developed conducting tissue (**Fig. 1 D**). *Leucobryum* found in moist areas on tree bark shows less developed conducting strand (**Fig. 1 E**). *Bryum* species show a wide array of conducting elements from well developed to poorly developed strands, depending upon the distribution. Taxa of dry habitats show well developed strand.

(B) *Conducting tissue in relation to the habitat* : The taxa which are found on hard substrates such as rocks (*Pogonatum*, *Bryum*) have a well-developed conducting system (**Figs. 1B, 2C, D**), whereas those on permeable substrata, have poorly differentiated conducting strand. *Sphagnum* species which occurs in aquatic habit lacks conducting strand at all. Epiphytic Isobryales possess a rudimentary system of central conducting tissues with thick-walled cortical cells (**Fig. 3 B**). Thick walled cells maintain the turgidity and prevent rapid collapse in dry conditions. *Bryum plumosum* found near damp areas, possessed less developed conducting tissue, whereas *Bryum argentum* var. *lanatum* and *Bryum coronatum*, which were collected from arid habitat showed well developed conducting tissue. Families Polytrichaceae and Mniaceae represent the well developed. endohydric group (Proctor, 2000), but the presently studied population of *Plagiomnium integrum* shows poorly developed conducting strand (**Fig. 3A**). The taxa of arid areas follow both endohydric as well as ectohydric conduction.

(C) *Conducting tissue in relation to the growth forms* : Mosses show the predominating influence of ground water supply in determining the growth forms. Turf, cushion, weft and dendroid forms are related to dry conditions, so they acquired a differentiated internal conducting tissue as well as take the water through ectohydric system. The mosses with mat and the pendant (*Meteorium* spp.) have rudimentary or undifferentiated conducting cells (**Fig. 3B**) as their plant parts remain in contact with moist substrata or can directly absorb water from the air. The pendant forms require more mechanical strength so they develop more thick walled cells in the cortex. The prostrate forms such as *Brachythecium* spp. totally lack specialized conducting cells (**Figs. 3C, D**)

(D) *Conducting tissue in relation to the leaf cell patterns* : The mosses with the leaves showing plication, linear cell pattern, absence of costa or rudimentary costa represent the poor conducting system (e.g. *Leucodon sciuroides*). The mosses with papillate leaf cells and defined costa, show a well defined tissue for water conduction (e.g. *Bryum* and *Hyophila*). In *Bryoerythrophyllum*, the costa and the leaf cells both show

papillae, which indicate water retaining system. *Splachnobryum* spp. have broad leaf cells and ephemeral habit in suitable habitat such that the water economy is compensated and the plant does not need much water but is efficient in assimilation by large leaf cells. In some cases, the leaves possess well developed stereidal cells in the costa region indicating that the plants can survive in prolonged dry conditions and maintain water continuity through leaves and stem. In *Sphagnum*, the hyalocysts can retain enough water for longer duration and the internal specialized conducting cells are not required. There is a trend that the plants with narrow laminal cells possess poorly developed internal conducting system but well developed external conducting system. The plants with large laminal cells have moderate conducting tissue. The conducting tissue is well developed in leaves and stem of the plants that have small, rounded and papillate laminal cells.

*Table 1* : Conducting elements in respect to the growth forms, habitat and leaf cell pattern  
(laminal cells small, rounded or quadrate) :

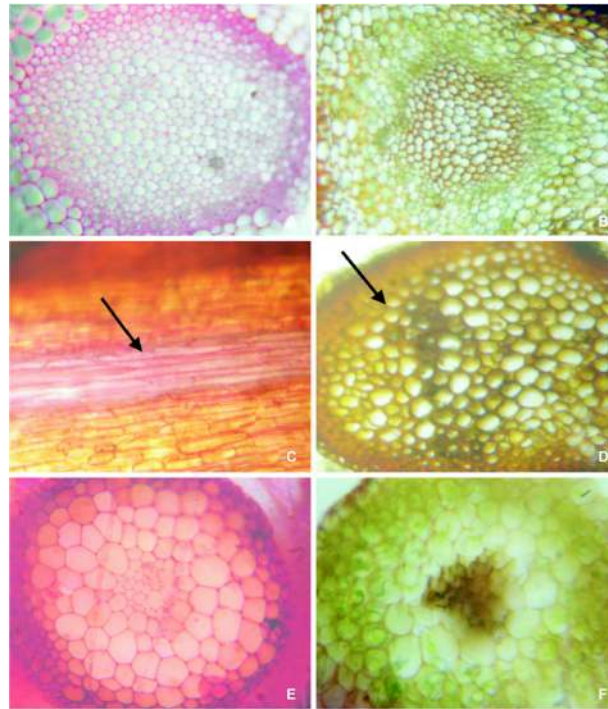
Taxon	Habitat	Growth form	Leaf cell pattern	Conducting cells
<i>Sphagnum junghuhnianum</i>	Aquatic	Tall turfs	Large hyalocysts and small chlorocyst	Absent ( <b>Fig. 1A</b> )
<i>Atrichum longifolium</i>	Mineral soil	Turf	Costate, cells small rounded	Distinct thin walled 4-5 layered.
<i>Pogonatum fastigiatum</i>	Rocks	Dendroid	Costate, cells rounded-quadrate	Well defined strand, 5-6 layered, thick walled cells ( <b>Figs. 1B, C</b> )
<i>Pogonatum proliferum</i>	Porous soil	Dendroid	Costate, cells irregular, thick-walled	Well-developed strand. Cells thick walled and 6-7 layered, surrounded by patches of leptoids
<i>Pogonatum urnigerum</i>	Soil gathered on rocks	Dendroid	Lamina cells are small, thick-walled and quadrate costa present with stereidal cells	Well developed thick walled tissue, 6-7 layered, surrounded by patches of food conducting cells
<i>Dicranella pseudosubulata</i>	Rocks	Cushion	Cells small rectangular. Rectangular cells at the base of lamina.	Well-developed strand of 4-5 layers
<i>Dicranum lorifolium</i>	Exposed rocks	Turf	Costate, cells small and incrassate	Well differentiated central tissue, 4-5 layered ( <b>Fig. 1D</b> ).
<i>Leucobryum humillimum</i>	Tree barks	Cushion	Broad costa, scabrous pattern of cell type and elevated cells.	Defined zone of central tissue 4-5 layers and have thin walled cells ( <b>Fig. 1E</b> )
<i>Fissidens zollingeri</i>	Wet rocks	Turf	Costate, cells lax, quadrate-hexagonal, small	Central strand of moderately thickened cells of 4-5 layers
<i>Hyophila involuta</i>	Rocks	Turf	Cells small, mamillate, rounded-quadrate	Conducting cells are 3-4 layered, pigmented ( <b>Fig. 1F</b> )
<i>Semibarbula orientalis</i>	Old walls and cement floors.	Turf	Costate, small cells multipapillose, rounded quadrate-hexagonal	Thin walled conducting cells-2-3-layered surrounded by stereidal cells.
<i>Bryorythrophyllum recurvirostrum</i>	Wet soils	Turf	Costate, cells rounded-quadrate, multipapillose	Thin walled cells in centre 3-4 layered surrounded by 2 layers of moderately thickened cells

*Table 2 : Conducting elements in respect to the growth forms, habitat and leaf cell pattern (laminal cells wide and large) :*

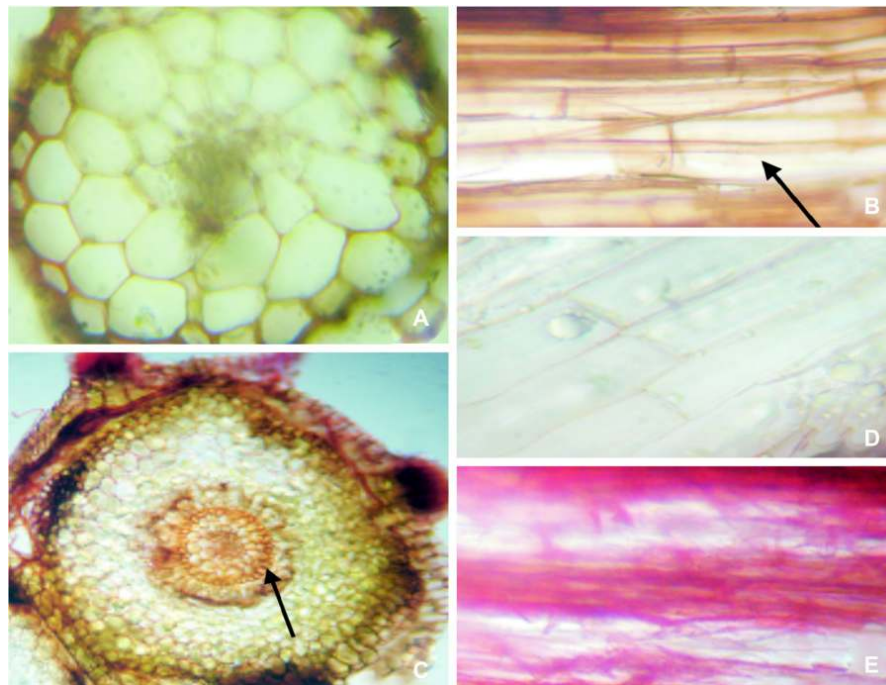
Taxon	Habitat	Growth form	Leaf cell pattern	Conducting cells
<i>Physcomitrium cyathicarpum</i>	Damp soil	Turf	Costate, cells are rectangular, broad and thick walled.	Conducting tissue 4-5 layered
<i>Funaria hygrometrica</i>	Soil	Turf	Costate, cells thick-walled and rectangular	Thick walled conducting tissue of 6-7 layered ( <b>Figs. 2A, B</b> )
<i>Splachnobryum synoicum</i>	Bricks	Turf	Cells small and hexagonal to rhomboidal	Extremely thin walled conducting tissue of 1-2 layers
<i>Bryum plumosum</i>	Wet soils	Turf	Cells are rhombic and broad	Conducting strand of thin walled cells 2-3 layered
<i>Bryum argenteum</i> var. <i>lanatum</i>	Dry soil, rocks	Turf	Wide rhombic, thin-walled cells, costa percurrent	Thin walled cells of 2-3 layered form the conducting strand.
<i>Bryum coronatum</i>	Cemented walls	Turf	Cells are broad and rhomboidal	Well developed and consist of three zones of tissues ( <b>Figs. 2C, D</b> )
<i>Plagiomnium integrum</i>	Wet soil	Turf	Costa percurrent. Leaf cells lax, thin walled, quadrate-hexagonal	Poorly developed ( <b>Figs. 2E, 3A</b> )
<i>Philonotis leptocarpa</i>	Calcareous rocks and marshy soils	Turf	Costa percurrent. Leaf cells thick-walled, rectangular, papillose	Thin walled and poorly differentiated, 2-3 layered
<i>Erpodium mangiferae</i>	Bark	Mat	Cells oval-hexagonal and large	Not differentiated
<i>Leucodon sciuroides</i>	Bark	Turf	Cells linear and thick walled, nerve absent	Not differentiated, some thick walled cells are scattered in the cortex.
<i>Meteorium buchananii</i>	Tree branches	Pendant	Costa present, cells narrow and linear	Not differentiated, thick walled cells are scattered in the cortex ( <b>Fig. 3B</b> )

(E) *Conducting tissue in relation to the systematic placement* : There is some correlation between the development of conducting tissues with regard to their systematic placement (*Tables 1 & 2*). The conducting strand is very much prominent in erect, acrocarpous orders such as Polytrichales, Dicranales, Funariales and Eubryales. The members of Pottiales which occur in dry habitats, also show a wide range of conducting tissues in respect to their habitat conditions. Isobryales show poorly developed conducting cells and the conducting cells are absent in the highly specialized group Hypnales. From the evolutionary point of view, the primitive types such as Polytrichales evolved well developed conducting system to compensate the erratic supply of water. However, in advanced groups like Hypnales the plant adjusts the water availability by following the ectohydric strategy.

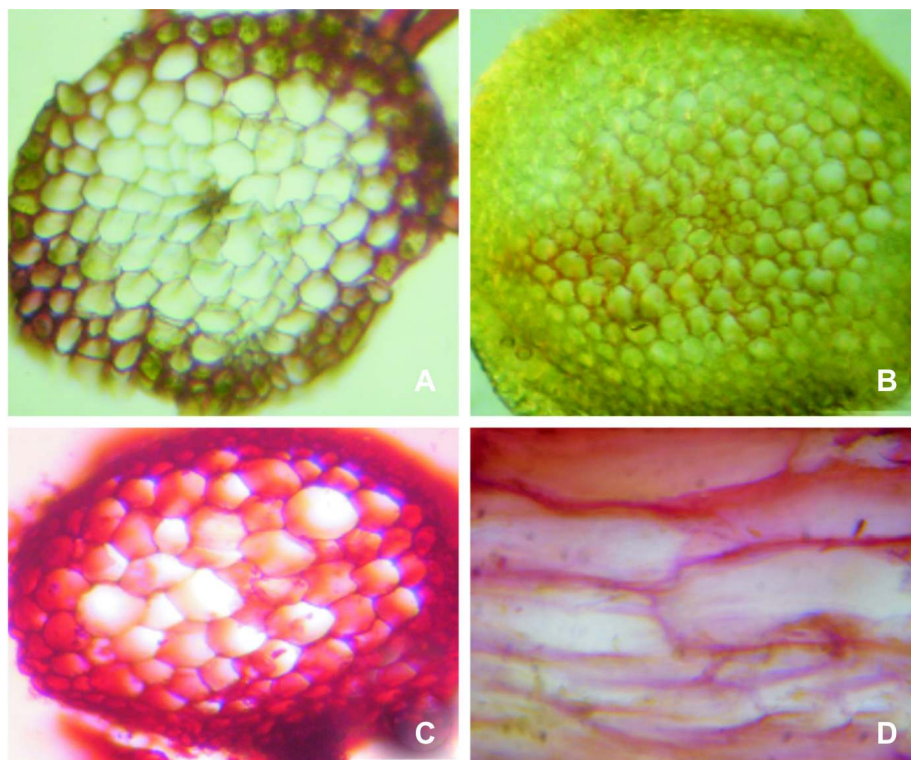
In spite of the great efforts made on the study of Indian mosses many areas still remain unexplored. Besides the floristic work on mosses, no attempt has so far been made to study the anatomical details of the mosses of India. The comprehensive survey of conducting tissues in mosses in relation to habitat and environmental conditions is completely lacking. Present study gives an insight to the development of conducting cells in relation to their distribution, habitat, growth forms and leaf cell patterns.



**Fig. 1:** A-T.S. stem of *Sphagnum* ( $\times 200$ ), B - T.S. stem of *Pogonatum fastigiatum* ( $\times 200$ ) showing, central core of conducting cells, C - L.S. stem of *P. fastigiatum* showing prominent conducting cells (arrows) ( $\times 300$ ) D - T.S. stem of *Dicranum lorifolium* ( $\times 400$ ) showing stereids in the outer cortex (arrow) E - T.S. stem of *Leucobryum humillimum* ( $\times 400$ ), F - T.S. stem of *Hypophila involuta* ( $\times 400$ ).



**Fig. 2:** A-T.S. stem of *Funaria hygrometrica* ( $\times 400$ ) showing poorly developed conducting cells, B - L.S. stem of *F. hygrometrica* showing conducting cells (arrow) ( $\times 400$ ), C - T.S. stem of *Bryum coronatum* ( $\times 200$ ) showing central thick-walled cells and pigmented cells (arrow) surrounding them, D - L.S. stem of *Bryum coronatum*, E - L.S. stem of *Plagiommium integrum* ( $\times 300$ ).



**Fig. 3:** A-T.S. stem of *Plagiomnium integrum* ( $\times 400$ ), B - T.S. stem of *Meteorium buchananii* showing thick walled cells in the ground tissue ( $\times 400$ ), C - T.S. stem of *Brachythecium plumosum* ( $\times 400$ )  
D - L.S. stem of *B. plumosum* ( $\times 500$ ).

#### ACKNOWLEDGEMENTS

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## एक्रोकार्पस मॉस में संचालन तत्त्व का टैक्सोनामिक आशय

एस. सिन्हा, एच. गोविंदप्यारी, एस. सुमन व पी.एल. उनियाल

### सार संक्षेप

प्रस्तुत शोध में एक्रोकार्पस मॉस के नौ वर्गों में संचालन तत्त्वों की संरचना एवं विकास का वर्णन है। मॉस के आवास स्थिति, बढ़ने का स्वरूप एवं पत्र कोशिका प्रणाली से संबंधित संचालन ऊतकों के महत्त्व की चर्चा है। तना के विभिन्न भागों में कोशिका के लक्षण, पटलीय कोशिका प्रणाली एवं शिरा पर विचार किया गया है। यद्यपिक जल-संचालक कोशिकाएं काई में अविशेषीकृत हैं परन्तु अध्ययन में देखा गया कि संचालन में उनकी जीवंत भूमिका है और टैक्सा के अंतर दिखाने में एक अतिरिक्त मापदंड है।

इनकी चार श्रेणी है (1) लेप्टोवाइड की पट्टियों से घिरे हुए हाइड्रोम के रूप में स्पष्टतः सघन दीवार वाली संचालन लड़ी (6-7 परत) वाले एक्रोकार्पस मॉस। छाल में सघन दीवार वाली कोशिकाएं (6-10 परत)। शिरा में स्टेरिडल कोशिकाएं, पत्तों में सुविकसित संचालनक तत्त्व उदाहरण पोलिट्रिकम (2) सघन दीवार वाले, संकीर्ण, लम्बी संचालक लड़ी (4-5 स्तर) छाल में कोणीय कोशिकाएं (6-8 परत)। सूजे हुए दीवार वाले अनियमित व छिद्रयुक्त, अनियमित, चतुष्कोणीय पत्र कोशिकाएं, उदाहरण डिक्लेनाम (3) विकास क्रम में विविधतापूर्ण मोटे या पतले दीवारयुक्त संचालक।



## THREE NEW RECORDS OF LIVERWORTS FOR HIMALAYAN REGION FROM MEHAO WILDLIFE SANCTUARY, ARUNACHAL PRADESH

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### ABSTRACT

Three liverworts, *Lophocolea muricata* (Lehm.) Nees (Geocalycaceae), *Cololejeunea jelinekii* Steph. and *C. nilgiriensis* G. Asthana & S.C.Srivast. (Lejeuneaceae) are described from Mehao Wildlife Sanctuary, Arunachal Pradesh. All the species are being reported for the first time from the Himalayan region.

**Keywords :** *Cololejeunea jelinekii*, *Cololejeunea nilgiriensis*, *Lophocolea muricata*, Himalaya region, Liverworts, New Records.

### INTRODUCTION

The ongoing taxonomic studies on the liverworts of Mehao Wildlife Sanctuary, Arunachal Pradesh revealed the occurrence of *Lophocolea muricata* (Lehm.) Nees (Geocalycaceae), *Cololejeunea jelinekii* Steph. and *C. nilgiriensis* G. Asthana & S.C.Srivast. (Lejeuneaceae). Of these, while *Lophocolea muricata* and *Cololejeunea nilgiriensis* are so far known in Indian bryoflora from Western Ghats (Srivastava & Srivastava, 2002; Asthana & Srivastava, 2003) only, *Cololejeunea jelinekii* is known from Nicobar Islands (Asthana & Srivastava, 2003). The same are described and illustrated for the first time from Himalayan region in general and the state of Arunachal Pradesh in particular.

### DESCRIPTION AND DISCUSSION

#### *Key to the species*

- 1a. Leaves simple, succubous, sub-opposite to opposite, ventrally free or united narrowly to broadly with adjoining underleaf bases on one or both sides; female bracts and bracteoles often larger or as large as the leaves and underleaves; whole plant surface covered with acute spines ... 1. *Lophocolea muricata*
- 1b. Leaves complicate bilobed, incubous, alternate, ventrally free; underleaves absent; female bracts sometimes similar to vegetative leaves or larger, bracteoles absent; leaf surface covered with blunt or subacute papillae ... 2
- 2a. Leaves slightly contiguous – distant, widely – slightly obliquely spreading; lobules up to 2/5 of lobe length, first tooth 1-2-celled, second tooth blunt; gemmae present ... 2. *Cololejeunea jelinekii*
- 2b. Leaves distant, obliquely spreading; lobules c. 1/2 or more than 1/2 of lobe length, first tooth 1-celled, second tooth subacute – obtuse, separated from first tooth by slight indentation, sometimes first and second tooth overlapping each other forming 'X'; gemmae absent ... 3. *Cololejeunea nilgiriensis*

**1. *Lophocolea muricata*** (Lehm.) Nees in Gottsche & al., Syn. hepat. 169. 1845; Abha Srivast. & S.C.Srivast., Indian Geocalycaceae 162. 2002. *Jungermannia muricata* Lehm. in Linnaea 4 : 363. 1829.

*Chiloscyphus muricatus* (Lehm.) J.J.Engel & R.M.Schust. in Nova Hedwigia 39 : 419. 1984. (Figs. 1; 4 A, B).

Plants delicate, prostrate, light yellowish green - pale brownish green, 7 - 10 mm long, 1.07 - 1.3 mm wide, rarely branched; branches lateral intercalary. Stem dorso-ventrally symmetrical, dorsal surface spinose, oval in outline in cross section,  $0.1 - 0.2 \times 0.15 - 0.2$  mm, 8 - 10 cells across; cells undifferentiated, subquadrate-rectangulate - ovate, thin-walled; cortical cells  $8 - 20 \times 8 - 18$   $\mu$ m; medullary cells  $8 - 28 \times 8 - 24$   $\mu$ m. Leaves alternate, imbricate, obliquely inserted, adaxially convex, ovate - quadrate to subtrapezoid, 0.4 - 0.9 mm long, 0.3 - 0.5 mm wide, bilobed, sometimes 3-lobed; lobes unequal, 8 - 17-cells long, 1 - 2-cells uniseriate at apex, 5 - 13 cells wide at base; dorsal margin straight, ventral margin slightly arched, margin and dorsal leaf surface covered with erect, acute spines; spines 1 - 3-cells long; leaf cells undifferentiated, subquadrate - polygonal, thin-walled with minute, triradiate trigones; apical lobe cells  $10 - 16 \times 12 - 16$   $\mu$ m; marginal leaf cells  $14 - 18 \times 10 - 14$   $\mu$ m; median leaf cells  $14 - 26 \times 8 - 18$   $\mu$ m; basal leaf cells  $22 - 40 \times 12 - 22$   $\mu$ m. Underleaves distant, free or connate with the adjoining leaves on one side of its base only, 0.2 - 0.37 mm long, 0.18 - 0.33 mm wide, bilobed up to 1/3 - 1/2 of underleaf length; lobes slightly divergent, narrow, 8 - 16 cells long, 4 - 9 cells wide at base, (2-) 3 - 6 cells uniseriate at apex, sinus narrow; lamina 4 - 7-cells long, 12 - 20-cells wide, with or without 1(-2) tooth at one or both lateral margins, tooth (1) 2 - 3 cells long, uniseriate throughout, a hyaline cell present at the apex of the lobes of teeth; entire margin and surface of underleaves covered with acute, 1-2-celled spines. Rhizoids in bunch at underleaves bases, branched at apices.

Dioecious. Male plants not seen. Gynoecia terminal on main shoot; bracts oblong, 0.5 - 0.6 mm long, 0.3 - 0.4 mm wide, bilobed, surface and margin covered with spines; bracteoles ovate, 0.4 - 0.5 mm long, 0.31 - 0.36 mm broad, bilobed 1/3 - 1/2 of its length, margins and surface covered with spines; perianth oblong, cylindrical, 0.9 - 1.2 mm long, 0.5 - 0.6 mm wide, mouth broad, 1/4 trilobed, 3-plicate; plicae extending up to 1/2 of perianth length from base towards apex; margins and surface covered with spines. Mature sporophyte not seen.

*Habitat* : Epiphytic, growing in moist and shady conditions in temperate forests.

*Distribution* : India : [Eastern Himalaya (Arunachal Pradesh - present study), Western Ghats (Tamil Nadu)], Indonesia, New Guinea, New Zealand, Australia, Africa (Srivastava & Srivastava, 2002).

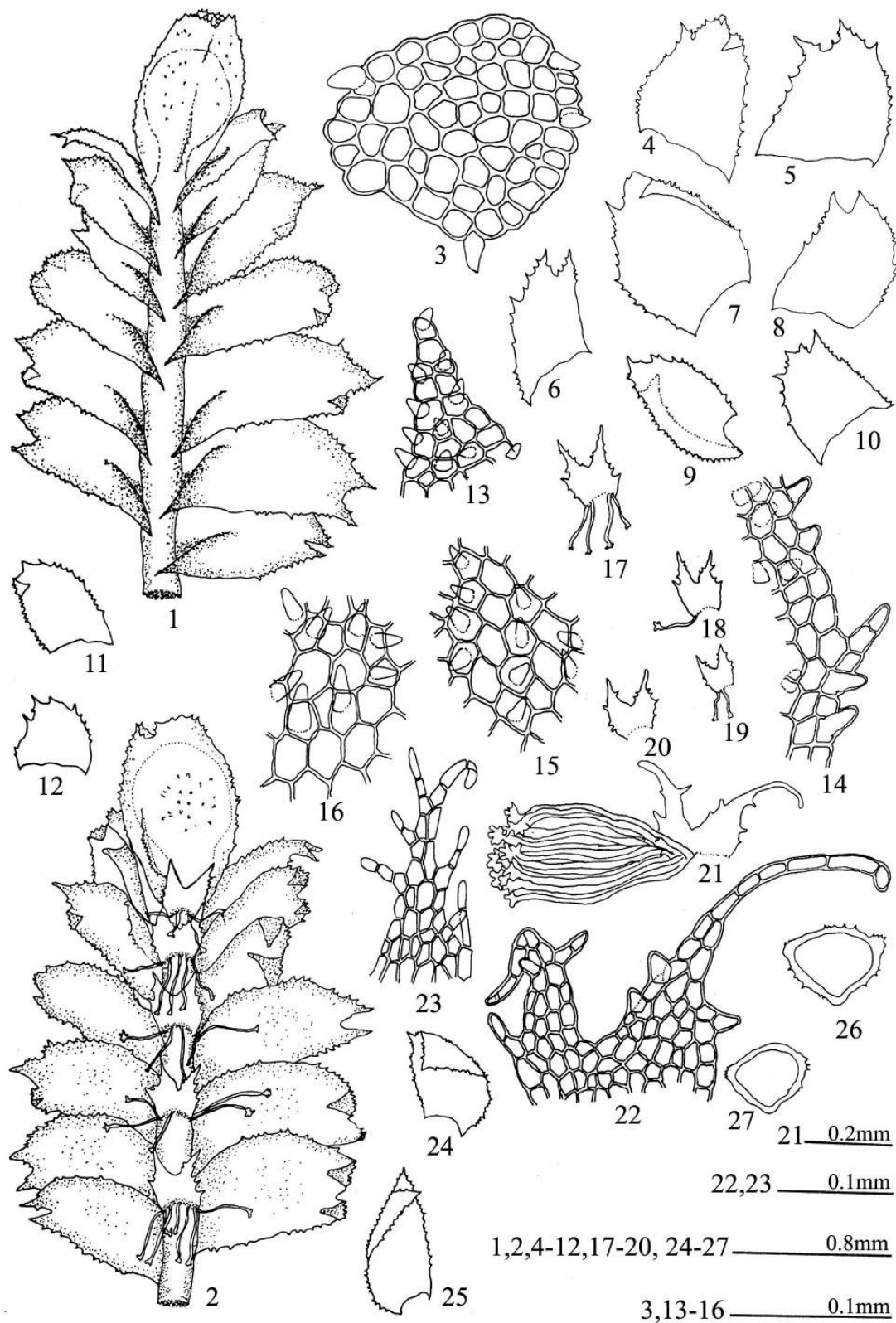
*Specimens examined* : India : Eastern Himalaya, Arunachal Pradesh, Lower Dibang Valley district, Mehao Wildlife Sanctuary, Mayodia Top, c. 2850 m, 18.11.2000, D.K. Singh 98220 (BSD); Mehao Lake - Gahori camp, c. 2450 m, 25.11.2000, D.K.Singh 98434 (BSD).

*Lophocolea muricata* is characterized by dioecious, light yellowish green - pale brownish green plants with all parts densely covered with erect, acute spines (Fig. 4 A, B); obliquely inserted, adaxially convex, ovate - quadrate to subtrapezoid leaves (Fig. 1 : 4 - 12); underleaves, either free or connate at base with adjoining leaves only on one side (Fig. 1 : 17 - 22) and oblong, cylindrical, 3-plicate perianth with plicae extending up to 1/2 the perianth length from base (Fig. 1 : 1, 2). The species was so far known in Indian bryoflora from Western Ghats alone.

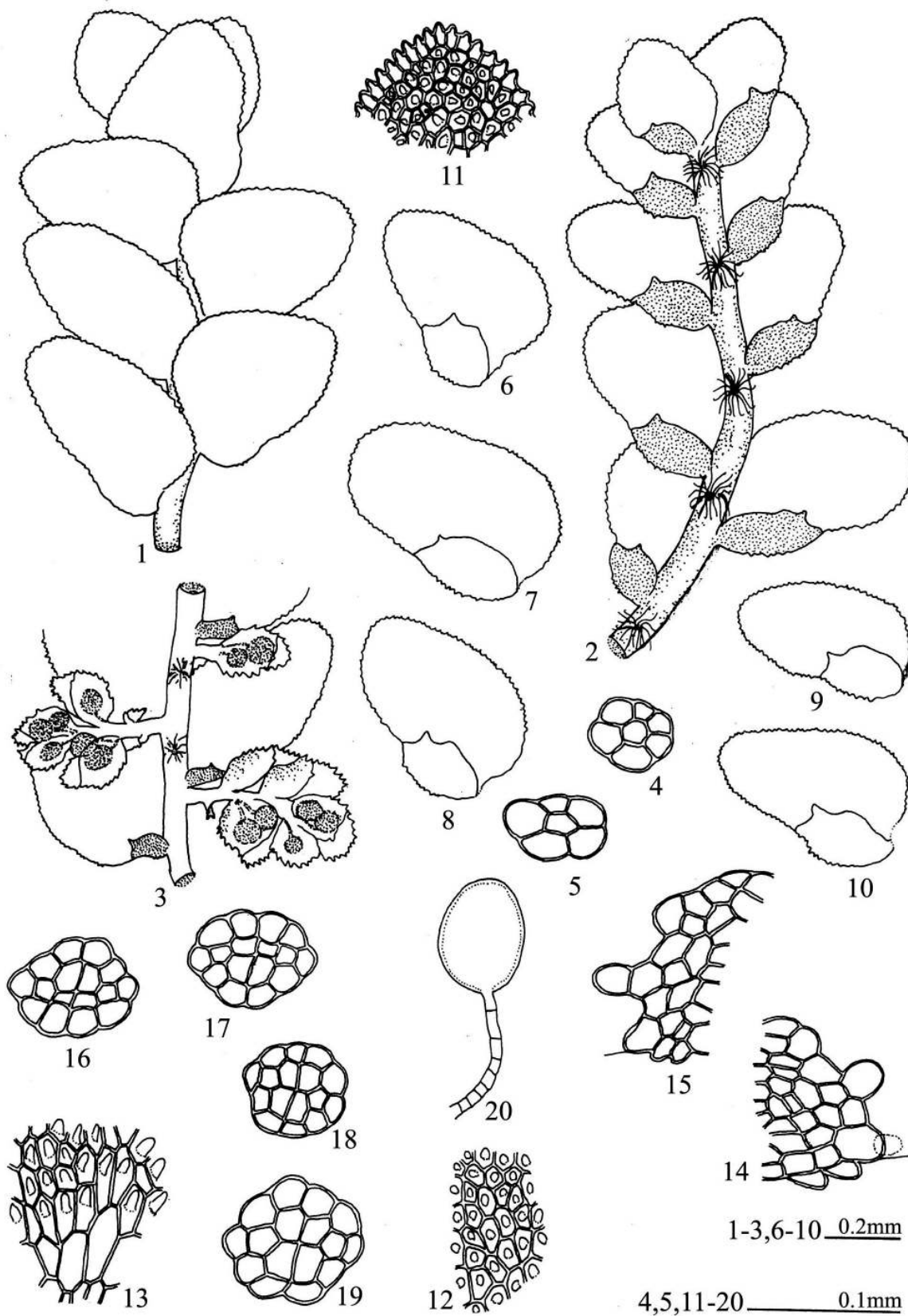
**2. Cololejeunea jelinekii** Steph. in Hedwigia 34 : 249. 1995; G. Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60 : 64. 2003. *Leptocolea jelinekii* (Steph.) Steph. in Sp. hepat. 5 : 851. 1916. (Figs. 2; 4 C, D).

Plants yellowish green in herbarium, appressed to the substratum, minute, 1.3 - 3.5 mm long, 0.5 - 0.65 mm wide, pinnately branched. Stem in cross section suborbicular - elliptic in outline, 0.04 - 0.05 mm; cortical cells in 5 (- 6) vertical rows, quadrangular - obtusoid,  $16.0 - 26.0 \times 12.0 - 22.0$   $\mu$ m, thin-walled; medullary cell 1, polygonal,  $12.0 - 14.0 \times 14.0 - 16.0$   $\mu$ m; ventral merophytes 3 cells wide. Leaves incubous, alternate, slightly contiguous - distant, widely - slightly obliquely spreading at an angle of 30 - 40° from the stem; leaf lobes oblong-ovate, 0.2 - 0.4 mm long, 0.16 - 0.27 mm wide, apex widely - narrowly obtuse, rounded; margin crenate due to projecting cells, dorsal margin arched, ventral margin nearly straight - slightly wavy; leaf cells dorsally papillose, thin-walled with indistinct trigones, intermediate thickenings absent; dorsal papillae blunt, 8.0 - 12.0  $\mu$ m high; apical leaf cells rectangular - quadrate,  $8.0 - 14.0 \times 8.0 - 12.0$   $\mu$ m; median leaf cells polygonal,  $10.0 - 14.0 \times 12.0 - 20.0$   $\mu$ m; basal leaf cells polygonal, slightly elongated,  $24.0 - 46.0 \times 14.0 - 20.0$   $\mu$ m; lobules ovate, inflated, 0.11 - 0.15 mm long, 0.06 - 0.09 mm wide, up to 2/5 of lobe length,





**Fig. 1.** *Lophocolea muricata* (Lehm.) Nees : 1. A portion of female plant with perianth in dorsal view; 2. The same in ventral view; 3. T. S. of stem; 4 -12. Leaves; 13. Apical lobe cells of leaf; 14. Marginal cells of leaf; 15. Median cells of leaf; 16. Basal cells of leaf; 17 - 20. Underleaves; 21. The same enlarged showing fasciculated rhizoids at the base; 22. The same enlarged; 23. Apical cells of underleaf lobe; 24 & 25. Female bracts; 26 & 27. T.S. of perianth.



**Fig. 2.** *Cololejeunea jelinekii* Steph. : 1. A portion of vegetative plant in dorsal view; 2. The same in ventral view; 3. A portion of male plant with androecial branch in ventral view; 4 & 5. T. S. of stem; 6 - 10. Leaves; 11. Apical cells of leaf; 12. Median cells of leaf; 13. Basal cells of leaf; 14 & 15. Leaf lobules; 16-19. Gemmae; 20. A single antheridium.

2-dentate, first tooth prominent, angular, 1 -2-celled, second tooth blunt, 1-celled, hyaline papillae indistinct. Rhizoids fasciculate, hyaline, forming rhizoidal disc on ventral stem surface. Gemmae present on dorsal leaf lamina, discoid, 64 - 84 µm in diameter, with 3 mamilliose adhesive cells.

Monoecious (?). Androeceia terminal on short lateral branches; male bracts in 3 - 4 pairs, ovate, inflated, margin crenate; antheridia 1 - 2 per bract, globose, c. 60 µm in diameter, stalk uniseriate, 8 - 9 cells long. Gynoecia not seen.

*Habitat* : Epiphyllous, growing densely all over the angiosperm leaf surface under moist and shady conditions.

*Distribution* : India : [Eastern Himalaya (Arunachal Pradesh - present study); Andaman & Nicobar Islands (Nicobar Islands)], Malaysia, New Guinea (Asthana & Srivastava, 2003).

*Specimens examined* : India, Eastern Himalaya, Arunachal Pradesh, Lower Dibang Valley, Mehao Wildlife Sanctuary, 4 km from Tewarigaon towards Mayodia, c. 2000 m, 20.02.2006, *M. Dey & S. Das* 38618, 38619, 38620, 38622, 38623, 38624, 38625, 38626, 38627 (CAL); 2 km from Tewarigaon towards Mayodia, c. 1700 m, 20.02.2006, *M. Dey & S. Das* 38628, 38634, 38637 (CAL); 1 km from Tewarigaon towards Mayodia, c. 1500 m, 20.02.2006, *M. Dey & S. Das* 38639, 38640, 38641, 38642, 38643, 38645, 38648, 38649 (CAL); Tewarigaon, c. 1500 m, 20.02.2006, *M. Dey & S. Das* 38658, 38659, 38660 (CAL).

*Cololejeunea jelinekii*, belonging to the subgenus *Cololejeunea* Benedix., is characterized by minute plants with oblong-ovate leaves (**Fig. 2 : 6 - 10**); densely papillose leaf surface (**Fig. 2 : 11 - 13; Fig. 4C, D**); 1 - 2-celled first tooth of lobule (**Fig. 2 : 14, 15**); discoid gemmae with three mamilliose cells (**Fig. 2 : 16 - 19**); terminal male inflorescence on short lateral branches with inflated male bracts bearing 1 - 2-antheridia (**Fig. 2 : 3**). Earlier the species was known in Indian bryoflora from Nicobar Islands only.

### 3. *Cololejeunea nilgiriensis* G. Asthana & S.C.Srivast. in Bryophyt. Biblioth. 60 : 27. 2003. (**Figs. 3; 4E, F**).

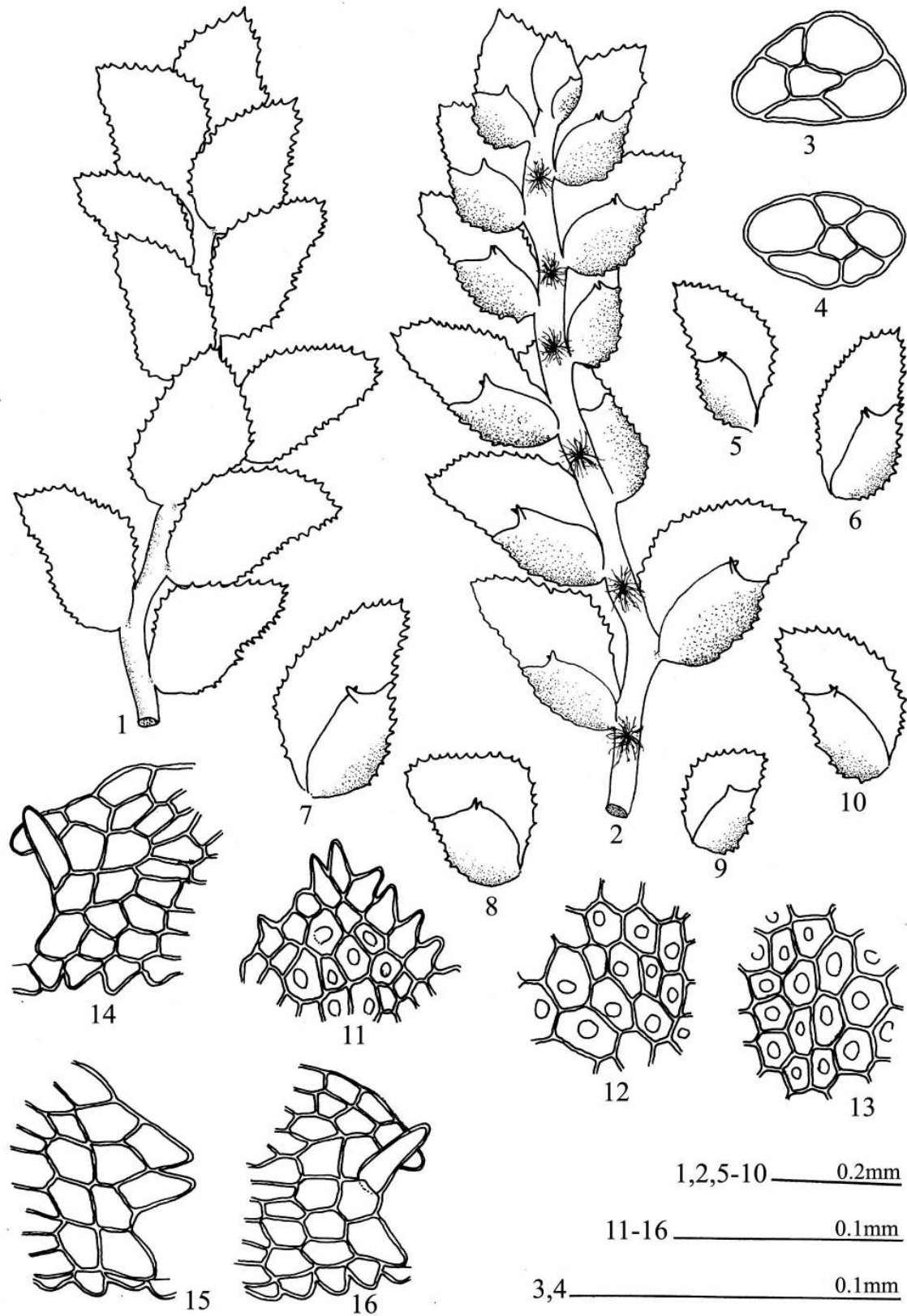
Plants whitish - light yellowish green in herbarium, appressed to the substratum, minute, 1.5 - 2.0 mm long, 0.5 - 0.6 mm wide, rarely branched. Stem in cross section triangular - elliptic in outline, 0.04 - 0.05 mm; cortical cells in 5 vertical rows, quadrangular - obtuse, 14.0 - 20.0 × 8.0 - 14.0 µm, thin-walled; medullary cell 1, polygonal, 12.0 - 14.0 × 8.0 - 10.0 µm; ventral merophytes 2-cells wide. Leaves incubous, alternate, distant, obliquely spreading from stem at an angle of 30 - 40°; leaf lobes oblong-ovate, 0.2 - 0.3 mm long, 0.12 - 0.16 mm wide, apex narrowly rounded; margin crenate due to projecting cells, dorsal margin arched, ventral margin nearly straight; leaf cells dorsally papillose, thin-walled with feeble trigones; intermediate thickenings absent; marginal spinose leaf cells quadrangular, 14.0 - 20.0 × 12.0 - 14.0 µm; median leaf cells polygonal, 10.0 - 20.0 × 12.0 - 22.0 µm; basal leaf cells polygonal, slightly longer than median cells, 20.0 - 56.0 × 10.0 - 14.0 µm; lobules large, ovate, inflated, 0.12 - 0.16 mm long, 0.06 - 0.10 mm wide, c. 1/2 or more than 1/2 of lobe length, 2-dentate; first tooth angular, 1-celled, second tooth subacute - obtuse, also 1-celled, separated from first tooth by slight indentation, sometimes first and second tooth overlapping each other forming 'X'; lobule margin crenulate. Rhizoids fasciculate, hyaline, forming rhizoidal disc on ventral stem surface. Gemmae absent. Fertile plants not seen.

*Habitat* : Epiphyllous, growing on angiosperm leaf surfaces under moist and shady conditions.

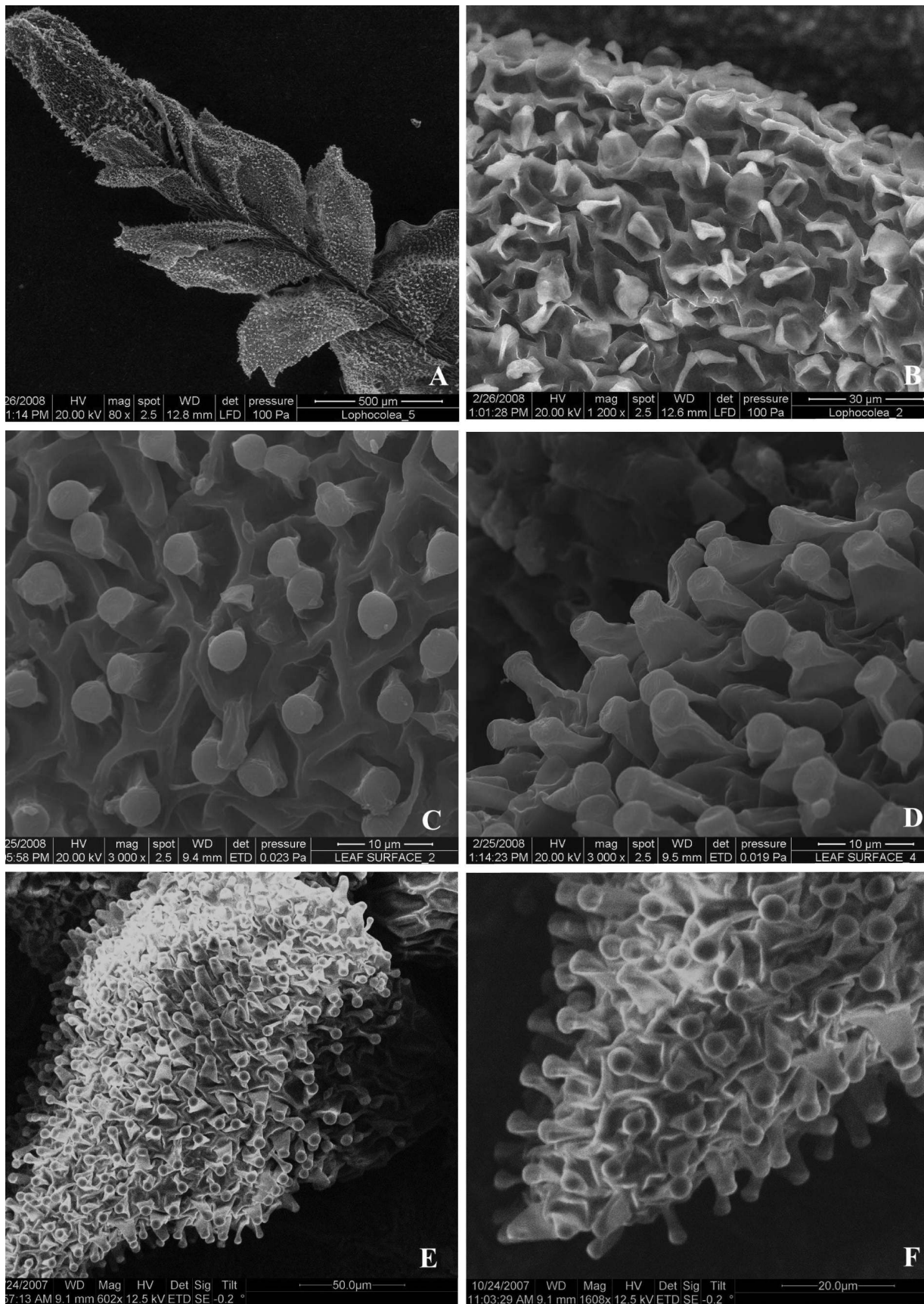
*Distribution* : India : [Eastern Himalaya (Arunachal Pradesh - present study), Western Ghats (Tamil Nadu)], endemic (Asthana & Srivastava, 2003).

*Specimen examined* : India : Eastern Himalaya, Arunachal Pradesh, Lower Dibang Valley, Mehao Wildlife Sanctuary, 6 km from Tewarigaon towards Mayodia, c. 2000 m, 20.02.2006, *S. Das & M. Dey* 38609 (CAL).

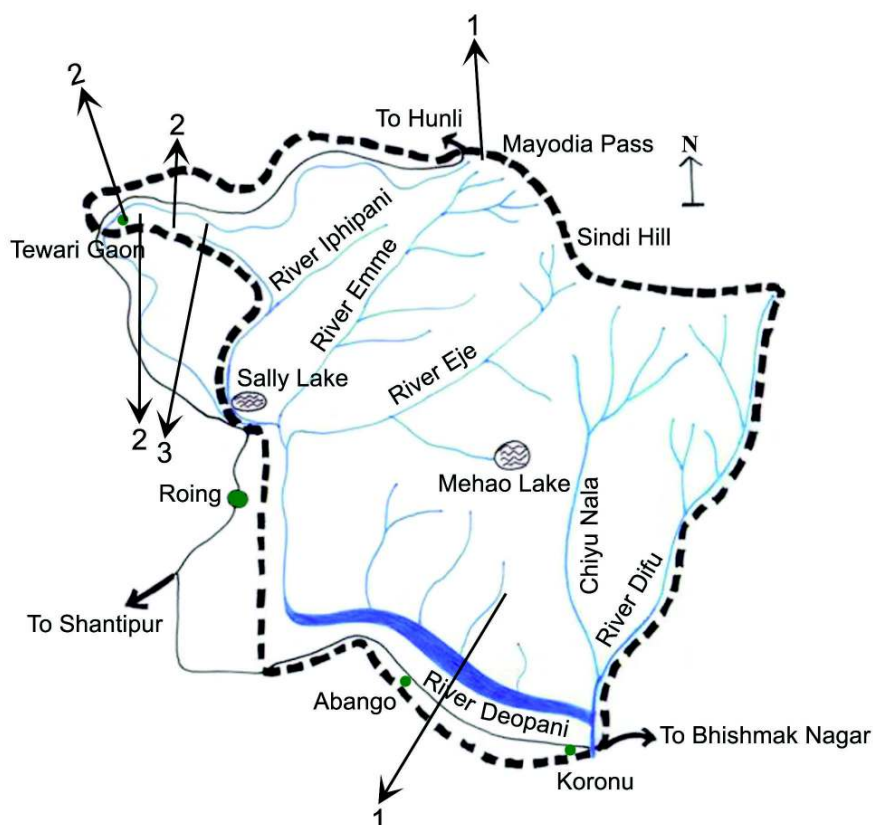
*Cololejeunea nilgiriensis*, belonging to the subgenus *Aphanolejeunea* (A. Evans) Benedix., is characterized by whitish - light yellowish green plants with oblong-ovate leaves with narrowly rounded apex and crenate margin (**Fig. 3 : 5 - 10**); densely papillose leaf surface (**Fig. 3 : 11 - 13; Fig. 4E, F**); large, ovate lobule, c. 1/2 or more than 1/2 of lobe length; angular, 1-celled first tooth and subacute - obtuse, 1-celled second tooth, separated from first tooth by slight indentation, sometimes first and second tooth overlapping each other forming 'X' (**Fig. 3 : 14 - 16**). The species is endemic to India and was so far known from Western Ghats alone.



**Fig. 3.** *Cololejeunea nilgiriensis* G. Asthana & S.C. Srivast. : 1. A portion of vegetative plant in dorsal view; 2. The same in ventral view; 3 & 4. T.S. of stem; 5-10. Leaves; 11. Apical cells of leaf; 12. Median cells of leaf; 13. Basal cells of leaf; 14-16. Leaf lobules.



**Fig. 4. :** Scanning Electron Microscope photographs of plants and leaf surface: A. A portion of the plant of *Lophocolea muricata* with perianth; B. A portion of the leaf of the same enlarged; C & D. *Cololejeunea jelinekii*; E & F. *Cololejeunea nilgiriensis*.



Map of Mehao WLS showing distribution of 1. *Lophocolea muricata*; 2. *Cololejeunea jelinekii* and *Cololejeunea nilgiriensis* (not to scale).

#### ACKNOWLEDGEMENTS

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### मेहाओ वन्यजीव अभयारण्य, अरुणाचल प्रदेश से हिमालय क्षेत्र के लिए लिवरवर्ट्स के तीन नये अभिलेख

सुदीपा दास एवं डी.के. सिंह

#### सार संक्षेप

मेहाओ वन्यजीव अभयारण्य से तीन प्रहरिता (लिवरवर्ट्स) लोफोकोलिआ म्युरिकेटा नीस (जिओकेलिकेसी), कोलोलिज्यूनिआ जेलिनेकी एवं कोलोलिज्यूनिआ नीलगिरिएंसिस (लेज्युनिएसी) के वर्णन किये गये हैं। हिमालय क्षेत्र से इन सभी जातियों की पहली रिपोर्ट है।



## THE USE OF ALTERNATIVE NAMES FOR A FEW WELL KNOWN ANGIOSPERM FAMILIES VIS-A-VIS FABACEAE VERSUS PAPILIONACEAE: HISTORICAL PERSPECTIVE

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### ABSTRACT

The paper is a brief historical resume on the genesis and development of familial concept as a natural unit in plants and its nomenclature. It explains in the backdrop of Latin grammar, how names with diverse terminations once dominated family nomenclature in taxonomic literature. It also narrates the logical efforts that followed to rationalize the family names to its present state leaving room for use of alternative names for a few angiosperm families. Besides, the paper discusses the proper use of the names Leguminosae, Fabaceae and Papilionaceae, and the associated problems.

**Keywords :** Alternative names, Family names, Latin Grammar, History, Fabaceae, Papilionaceae.

### INTRODUCTION

Plant nomenclature has attained an achievable stability. Any system devised or divined, which is dynamic like plant nomenclature, can never reach complete steadiness. Certain of the provisions in the Botanical Code which were deliberately incorporated for historical or other reasons, are sources of apparent instability and providing room for confusion. One such issue is the use of alternative names for certain of the familiar angiosperm families. There is an increasing demand for abandoning them and going for one name as envisaged in Principle IV of the Botanical Code which seeks one name for one taxon with a particular circumscription, position and rank. The recent three proposals (205-207) in this regard by Govaerts (2004) are a testimony to the persisting problem. The defeat of the proposals is also not an end of the issue in itself and perhaps cannot be avoided till a more rational solution is achieved. Therefore, for a proper introspection, this contentious issue is brought to the fore again, emphasizing its historical perspective.

The discovery of more and more of novel plants at the beginning of 18th century put before the botanists in Europe the stupendous task of naming, describing and publishing them. In the process, the science of nomenclature was given a definite direction and destiny by Carolus Linnaeus with the publication of *Species Plantarum* (1753) and *Systema Naturae* (1759). Yet, in the absence of any generally accepted rules of nomenclature other than those elemental principles propounded by Linnaeus, the botanical nomenclatural patterns and practices were set by the then Botanists of considerable prestige and repute. On the whole, some of these were different from those which were in vogue later.

As the time passed, the inadequacies in plant nomenclature surfaced; the need for initiation of organized corrective measures to standardize plant nomenclature became increasingly apparent. It resulted in enacting a unified nomenclatural procedure, *i.e.*, the International Rules of Botanical Nomenclature, to start with the Paris Code, 1867 (The de Candolle Rules). The declared objective of the Rules, embodied subsequently as Articles in the Code, is to put the nomenclature of the past into order and to provide for that of the future. In other words, all the corrective measures to standardize the botanical nomenclature began much after the same attained a certain stature independent of any internationally agreed rules. As and when many of the “proposed rules” were put into practice during the formative era of the Code, the inherent deficiencies of some of the rules became clear. In fact, the demand for the conservation of established names contrary to Principle of

Priority [of publication] was first voiced by German Botanical Society in 1897. It was due to the fact that many botanists became dismayed by the magnitude of name changes suggested by O. Kuntze in *Revisio Genera Plantarum* (1891-98). As it is impossible to legislate for every eventuality, there is a provision in the Code for periodical modification of Code itself.

#### CONCEPT OF FAMILY AS A NATURAL UNIT

**Linnaeus and the Natural Order** : The two massive classics of pre-Linnean era, namely *Rariorum Plantarum Historia* (1601) by Carolus Clusius and *Historia Plantarum* (1686-1704) by John Ray, greatly influenced Carolus Linnaeus in conceiving his *Species Plantarum*. He intended that *Species Plantarum* together with *Genera Plantarum* will provide a simple means of referring all the known plants of the world.

There existed systems of classification based on form, gross morphology of plant structures, etc., before the time of Linnaeus. But none of those systems was adequate and simple enough to accommodate the increasing number of newly described plants, nor could be easily used to identify the already known ones. Linnaeus, therefore, introduced a system of classification in the 1st edition of *Systema Naturae* (1735), and employed the said classification in arranging plants in *Species Plantarum* and *Genera Plantarum*. It is a simple but ingenious arithmetical system whereby the genera are grouped into 24 classes according to number, union, length, etc. of stamens. The classes were then subdivided into orders on the basis of number of pistils. It is true that the sexual system mentioned above is usually associated with the name of Linnaeus. But it is seldom known that Linnaeus himself was critical about the system and freely acknowledged the inadequacy of the same (*Classes Plantarum* 440. 1738). He was compelled to adopt the system in *Species Plantarum* and *Genera Plantarum* for no other system then available could be used to achieve his cherished objective. Though, at that time, the concept of evolution was not there, yet from his vast experience in the study of nature in Western Europe (1735-37), Linnaeus firmly believed that there certainly existed more close, natural and orderly relationship in the creation of God. He, therefore, felt the need for such a method to bring together into groups the plants which resemble each other in their botanical qualities and also knew it was all the more hard to write (*Genera Plantarum, Ratio Operis* No.1. 1737). He even outlined what he thought might be such a system, publishing a first draft, '*Fragmenta Methodi Naturalis*' – an incomplete work as the name implied, in *Classes Plantarum* (1738). Here he drew an outline of 65 orders in a schematic form by placing the related genera under each Order. About the same time, Linnaeus also contributed a natural classification – 'Clavis Classium' to Adriaan van Royen, *Florae Leydensis Prodrromus* (1740).

In the preface of '*Fragmenta Methodi Naturalis*' (*Classes Plantarum* 485-488. 1738), Linnaeus remarked: 'A truly natural method is the highest goal of systematic botany ... No one has so far succeeded in designing a true natural method. I [Linnaeus] have labored long trying to work out such a method, and done all I could, without reaching my aim. I will work at this task my whole life, publishing what I shall discover.... It is impossible to give a key of the natural method before having placed every plant correctly as to order. It is not enough to define an order using the common characters of its genera, but data must be provided in addition by which one order can be set aside from another. My work is restricted to orders [*i.e.*, families in the modern sense] because once these are correctly placed, the classes [*i.e.*, orders in the modern sense] can be worked out at ease. No a priori rules can be laid down to write a natural method, and no part of flower and fruit comes first in sequence of the character to be used. All that may count toward such a method is the symmetry of every part, which is often peculiar to each group... Let everybody correct, extend, and perfect this method who can. Let those leave it alone who cannot. Those who can are the best of botanists'. [Croizat, Bull. Torrey Bot. Club 72: 57-58, 1945].

In the sexual system of Linnaeus, the orders were glaringly artificial in composition while in the natural system each of these were composed of genera supposedly expressive of their true affinities hence called 'Natural Order'<sup>1</sup>, now known as family, a term of French origin and appears to have been introduced by Pierre Mangol (1638-1715) in his *Prodrromus historie generalis* ... (1689). Thus, we find genesis of modern familial concept in Linnaeus's *Classes Plantarum* (1738), a land mark publication in Botany.

<sup>1</sup>Paris Code (1867) maintained the then term Order (*Ordo*) or Natural Order (*Ordo naturalis*) as synonymous to French term 'Family'.



Linnaeus published his '*Fragmenta*' anew with little change in *Philosophia botanica* (1751) providing the orders special descriptive names and also adopting for the orders similar such names already in use as 'descriptive terms' in plant classification in pre-Linnaean texts. Linnaeus, however, did not give up his thoughts on '*Fragmenta Methodi Naturalis*' and went on perfecting his ideas with the knowledge then available. In the sixth edition of *Genera Plantarum* (1764), Linnaeus thus appended a section on his '*Ordines Naturales*' which he introduced with 11 aphorisms reiterating his thoughts on natural system of classification, for example:

10. '*Ordines naturales valent de natura plantarum. Artificiales in diagnosi plantarum.*' ['Natural orders indicate the nature of plant. Artificial orders are effectual for identification of plants.']
11. '*Genera qui condit naturalia, Naturales ordines ibi, ubi licet, perspectos reddat.*' ['He who founds natural genera should refer them to the Natural orders where possible.']

Accordingly, Linnaeus added serial numbers to all the genera following *Genera Plantarum* in the schema of his *Ordines Naturales*. Later on, he gave his much considered views in two series of lectures to the two select little gatherings of his students, the first in 1764 to Ferber, Fabricius, Zoega, Meyer and Kuhn who had come from Philadelphia, and the second in 1771 to Giseke, Vahl, Edinger and Tisler. From his own notes and those of Fabricius, Giseke published in 1792 Linnaeus's *Praelectiones in Ordines naturales Plantarum*. Even today, Piperaceae ('Piperitae'), Papilionaceae and Compositae carry the name of Linnaeus in a true sense though these are attributed to his student Giseke on nomenclatural ground, who compiled, edited and published the lectures ('*praelectiones*') of Linnaeus posthumously.

**de Jussieu and the Natural Order :** Meanwhile, further major developments in natural classification initiated by Linnaeus in 1738 took place in France. Bernard de Jussieu (1699-1777), a French contemporary of Linnaeus and Professor of Botany at Royal Gardens, Trianon in Versailles, while attempting to lay plants according to a natural system in the Botanical Gardens of Trianon and Paris brought about a number of modifications to Linnaean system. It appears that at the time Bernard was also in possession of a draft manuscript of Adanson's '*Familles des Plantes*' which was alleged to have been sent to him in 1750 from Senegal in West Africa where Adanson was engaged in the study of plants and animals. But never being completely satisfied with the changes he could bring about to the systems of Linnaeus and Adanson, Bernard did not publish his results.

Antoine Laurent de Jussieu (1748-1836), who joined his uncle Bernard at the Royal Gardens at a very young age and then succeeded him there, brought about a significant improvement to his uncle's incomplete and unpublished system of classification. In fact, Bernard's quiet deed – observing natural system of classification live at work in gardens, greatly influenced the botanical thoughts of younger de Jussieu. In 1789, A.L. de Jussieu published his *Genera Plantarum secundum Ordines naturalis disposita* [Arrangement of Plant Genera according to Natural Orders, i.e., Families] – the first complete system which can be claimed a natural one. In the preface of his work A.L. de Jussieu also published (pp.LXIII – LXX) his uncle's manuscript, '*Bernardi de Jussieu, Ordines naturalis, In Ludovici XV Horto Trianonense Dispositi, Anno 1759*' – again a schematic representation of 48 orders with their included genera. In A.L. de Jussieu's work, the orders (i.e., families) which number 100 are carefully characterized, clearly differentiated and named. The excellence of the work lay in the fact that in all modern classifications nearly all of them are recognized as distinct. It is perhaps because of this uniqueness of the work, A.L. de Jussieu's *Genera Plantarum* (1789) has been accepted as starting point date for family names of Spermatophyta<sup>2</sup> (Art. 13.1 & Appendix IIB, Vienna Code, 2006).

**Adanson and the Plant Family :** Michel Adanson (1727-1806), a French botanist, enriched by his vast experience as an explorer in west tropical Africa, published second volume of his two volume work, '*Les*

<sup>2</sup> Lately it was noticed that the starting point for publication of supra generic names of Spermatophyta was included in Montreal Code (1961) on the basis of an informal decision in Montreal Congress (1959). The provision was not therefore included in any articles of the Code. When an attempt to ratify the decision in Tokyo Congress (1993) failed, there was a temporary setback which was reflected in the authorship, date and place of publication of some family names in Appendix IIB, St. Louis Code (2000). However, a decision of the Vienna Congress (2005) restored the original basis of Spermatophyta family names in Appendix IIB, dating to Montreal Congress (1959).

*Familles des Plantes*' in 1763. Therein though Adanson named and properly described for the first time 58 plant families, 'his lavish incorporation of doubtful or ill-known genera' in many of these families, systematists in general did not consider his familial concept better than Linnaeus's '*Fragmenta*'.

#### FAMILY NOMENCLATURE

As stated earlier, the first conscious attempt to name<sup>3</sup> the families ('orders') was there in *Philosophia botanica* (pp.27 - 36. 1751) when the concept of order as a natural unit fairly crystallized. There under '77. METHODI NATURALIS Fragmenta...' Linnaeus gave special descriptive names like Bicornes, Spathaceae, Scabridae, Vepreculae, etc., and adopted similar such names for the orders – Piperitae, Palmae, Orchideae, Liliaceae, Gramina, Compositi, Umbellate, Cariophyllae, Cucurbitaceae, Papilionaceae, and the like from the works of his predecessors<sup>4</sup> though these were in use there in a different context (Fig.1).

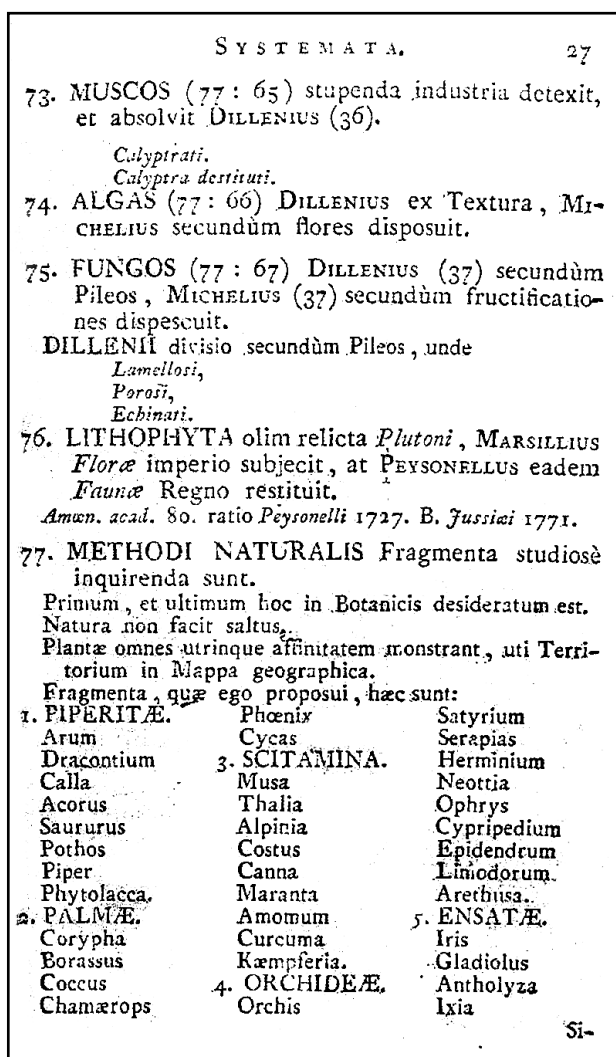
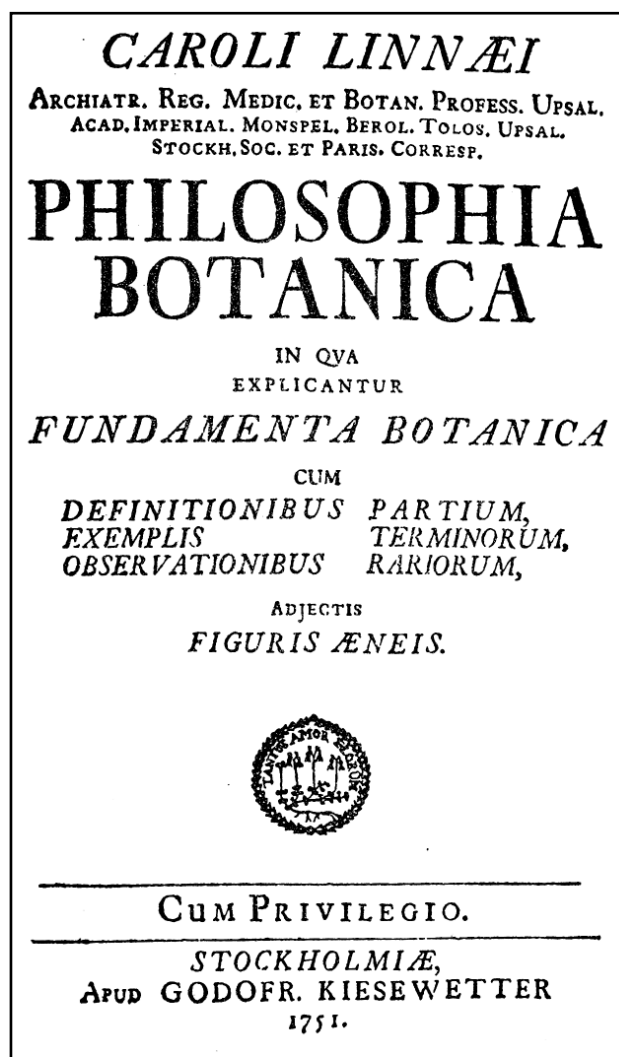


Fig.1 : Title page of *Philosophia botanica* (1751) and a page of 'Fragmenta'.

<sup>3</sup>A few such names were already used as name of Classes in *Florae Leydensis Prodrömus* (1740) which Linnaeus helped van Royen to prepare in 1738 (Stearn, 1959: 96). Sprengel (1824: 44), however, claims that Linnaeus actually wrote the flora for van Royen – [*Florae Leidensis prodrömus*. LB., 1740. 8. Linnaeus scripsit ('Linnaeus written it'), non Royenus...]

<sup>4</sup>I) Boerhaav, Hermann, *Ind. pl. hort. Lugd.-Bat.* Leiden 1710 & *Ind. alter hort. Lugd.-Bat.* Leiden 1720. II) Hermann, Paul, *Fl. Lugd.-Bat.* Leiden 1690. III) Morison, Robert, *Pl. hist. Univ.* vol. 2 & 3. Oxford 1680-99. IV) Ray, John, *Meth. Pl.* London 1682; *Meth. Pl. em.* London 1703; *Hist. Pl.* vol. 1-3. London 1686 - 1704 & *Syn. meth. strip. brit.* ed.1-3. London 1690-1724. V) Tournefort, Joseph Pitton, *Elem. Bot.* 3 vol. Paris 1694 & *Inst. rei herb.* Paris 1700.

Adanson (1763), however, preferred to use almost exclusively the plurals of a characteristic constituent generic name as the name of families. The prevailing French custom of using plurals of vernacular names to refer groups of such plants like, 'Les Anones', 'Les Amaranthes', 'Les Rosiers' (*i.e.*, the Anonas, the Amaranths, the Roses), etc., appears to have influenced Adanson to use the Latin equivalents like Anonae, Amaranthi, Rosae, etc., as the family names. Such adoption of plurals of a characteristic constituent generic name as the family name even though was not appreciated afterwards, yet it helped to conceive the concept of type genus of a family<sup>5</sup> at a later date. Adanson also adopted traditional names like Palmae, Liliaceae, Compositae, Labiatae, Leguminosae and Cruciferae.

A.L. de Jussieu and his uncle Bernard de Jussieu (Gen. Pl. 1789 & pp. LXIII-LXX) gave little thought to the nomenclatural issue. Both of them followed Adanson (1763) in using plurals of the generic names as family names, at the same time liberally adopted traditional names ending in '–ae', '–eae', '–aceae' and '–oideae'. The traditional names adopted by Bernard in his manuscript are Palmae, Gramineae, Rubiaceae, Umbelliferae, Labiatae, Cruciferae, Papaveraceae, Leguminosae, Cucurbitaceae, Rosaceae, and Aroideae. A.L. de Jussieu, in addition adopted names like Campanulaceae, Ranunculaceae, Guttiferae, Malvaceae, Tiliaceae and Rutaceae.

**Family Names and Latin Grammar:** It is thus seen that naming of certain natural groups of plants variously called orders or families has been full of inconsistencies. Although, Botanical Code has now articles (18 & 19) which deal with procedure for establishment of names of families and their subdivisions, earlier family names have not been formed by any single method. Unlike English, in Latin an adjective has to agree in gender, number and case of the noun it qualifies, *i.e.*, the ending of the adjective changes in accordance with the state of the noun it associates. Thus though a noun has only one gender, in Latin the adjective words exist in masculine, feminine and neuter genders. Botanical Latin has a rich store of such adjective words which ancient botanists liberally used as an 'independent noun' (to a lesser extent nouns also) to form newer descriptive terms to distinguish taxonomic categories in plant classification. Many such names were adopted by Linnaeus and his successors as family names. The following few examples fairly explains the grammatical implications of such names formed at the beginning:

Table-1. Examples of derivation of family names.

(I)	Cornu (N) – horn		Cornis (Adj.) – horned Bi-cornis (Adj.) – two horned	
	N O M	SINGULAR		
		M Bicornis	F Bicornis	N Bicorne
		PLURAL		
		Bicornes	<b>Bicornes</b>	Bicornia
(II)	Spatha (F) – spathe		Spathaceus (Adj.) – spathe-like	
	N O M	SINGULAR		
		M Spathaceus	F Spathacea	N Spathaceum
		PLURAL		
		Spathacei	<b>Spathaceae</b>	Spathacea
(III)	Scabri – (Latin comp.) – rough		Scabridus (Adj.) – somewhat rough	
	N O M	SINGULAR		
		M Scabridus	F Scabrida	N Scabridum
		PLURAL		
		Scabridi	<b>Scabridae</b>	Scabrida

<sup>5</sup>In the Brussels Code (1912), the type concept was first included as a 'Recommendation' which suggested among other things to indicate the typical genus in a family. In Cambridge Code (1935), type concept was included as 'Rules' and in Paris Code (1956) even as one of the six guiding principles (Principle II) of botanical nomenclature.

(IV)	Vepres (M) – thorn bush		Vepre – culus (Adj.) – diminutive of Vepres		
	N O M	SINGULAR			
		M Vepreculus	F Veprecula	N Vepreculum	
		PLURAL			
		Vepreculi	<b>Vepreculae</b>	Veprecula	
(V)	Piper (N) – peper, piperis		(a) Piperitus (Adj.) – having the quality of piper (b) Piperaceus (Adj.) – piper-like		
	(a) N O M	SINGULAR			
		M Piperitus	F Piperita	N Piperitum	
		PLURAL			
		Piperiti	<b>Piperitae</b>	Piperita	
	(b) N O M	SINGULAR			
		M Piperaceus	F Piperacea	N Piperaceum	
		PLURAL			
		Piperacei	<b>Piperaceae</b>	Piperacea	
	(VI)	Compo (Participle) – bringing together separate things		Compositus (Adj.) – put together, united	
		N O M	SINGULAR		
			M Compositus	F Composita	N Compositum
PLURAL					
<b>Compositi</b>			<b>Compositae</b>	Composita	
(VII)	(a) Gramen (N) – Grass		(b) Gramineus (Adj.) – Grassy, grass-like (c) Graminaceus (Adj.) – having the character of grass		
	(a) N O M	SINGULAR	PLURAL		
		Gramen	<b>Gramina</b>		
	(b) N O M	SINGULAR			
		M Gramineus	F Graminea	N Gramineum	
		PLURAL			
		Graminei	<b>Gramineae</b>	Graminea	
	(c) N O M	SINGULAR			
		M Graminaceus	F Graminacea	N Graminaceum	
		PLURAL			
		Graminacei	<b>Graminaceae</b>	Graminacea	

(VIII)	(a) Palma (F) – Palm tree		(b) Palmaceus (Adj.) – having the character of palm tree		
	(a) N O M	SINGULAR		PLURAL	
		Palma	Palmae		
	(b) N O M	SINGULAR			
		M Palmaceus	F Palmacea	N Palmaceum	
		PLURAL			
		Palmacei	Palmaceae	Palmacea	
(IX)	(a) Orchis (F) – Orchid		(b) Orchideus (Adj.) – Orchid-like (c) Orchidaceus (Adj.) – having the character of Orchid.		
	(a) N O M	SINGULAR	PLURAL		
		Orchis	Orchides		
	(b) N O M	SINGULAR			
		M Orchideus	F Orchidea	N Orchideum	
		PLURAL			
		Orchidei	Orchideae	Orchidea	
	(c) N O M	SINGULAR			
		M Orchidaceus	F Orchidacea	N Orchidaceum	
		PLURAL			
		Orchidacei	Orchidaceae	Orchidacea	
	(X)	Labia (F) – lip		Labiatum (Adj.) – lipped	
N O M		SINGULAR			
		M Labiatum	F Labiate	N Labiatum	
		PLURAL			
		Labiatum	Labiate	Labiate	
(XI)	(a) Lilium (N) – lily		(b) Liliaceus (Adj.) – lily-like		
	(a) N O M	SINGULAR	PLURAL		
		Lilium	Lilia		
	(b) N O M	SINGULAR			
		M Liliaceus	F Liliacea	N Liliaceum	
		PLURAL			
		Liliacei	Liliaceae	Liliacea	
(XII)	Papilionis (M) – Butterfly		Papilionaceus (Adj.) – butterfly-like (corolla)		
	N O M	SINGULAR			
		M Papilionaceus	F Papilionacea	N Papilionaceum	
		PLURAL			
	Papilionacei	Papilionaceae	Papilionacea		

(XIII)	Legumen (N) – Pea or bean		(a) Leguminaceus (Adj.) – legume-like (b) Leguminosus (Adj.) – legume bearing	
	(a) N O M	SINGULAR		
		M Leguminaceus	F Leguminacea	N Leguminaceum
		PLURAL		
		Leguminacei	<b>Leguminaceae</b>	Leguminacea
	(b) N O M	SINGULAR		
		M Leguminosus	F Leguminosa	N Leguminosum
		PLURAL		
Leguminosi		<b>Leguminosae</b>	Leguminosa	
(XIV)	Umbella (F) – parasol		(a) Umbellifer (Adj.) – umbel bearing (b) Umbellatus (Adj.) – umbel-like	
	(a) N O M	SINGULAR		
		M Umbellifer	F Umbellifera	N Umbelliferum
		PLURAL		
		Umbelliferi	<b>Umbelliferae</b>	Umbellifera
	(b) N O M	SINGULAR		
		M Umbellatus	F Umbellata	N Umbellatum
		PLURAL		
<b>Umbellati</b>		Umbellatae	Umbellata	
(XV)	Caryo – phyllum (Latin comp.) – nut-bearing leaf Caryo – phyllus (Greek comp.) – nut-bearing leaf		(a) Caryophyllaceus (Adj.) – nut-leaved (b) Caryophyllaeus (Adj.) – nut-leaved (c) Caryophylleus (Adj.) – nut-leaved (d) Caryophylloideus (Adj.) – nut-leaved	
	(a) N O M	SINGULAR		
		M Caryophyllaceus	F Caryophyllacea	N Caryophyllaceum
		PLURAL		
		Caryophyllacei	<b>Caryophyllaceae</b>	Caryophyllacea
	(b) N O M	SINGULAR		
		M Caryophyllaeus	F Caryophyllaea	N Caryophyllaeum
		PLURAL		
		<b>Caryophyllaei</b>	Caryophyllaeae	Caryophyllaea
	(c) N O M	SINGULAR		
		M Caryophylleus	F Caryophyllea	N Caryophylleum
		PLURAL		
		<b>Caryophyllei</b>	<b>Caryophylleae</b>	Caryophyllea
	(d) N O M	SINGULAR		
		M Caryophylloideus	F Caryophylloidea	N Caryophylloideum
		PLURAL		
		Caryophylloidei	<b>Caryophylloideae</b>	Caryophylloidea

(XVI)	Cucurbita (F) – gourd		Cucurbitaceus (Adj.) – gourd-like	
	N O M	SINGULAR		
		M Cucurbitaceus	F Cucurbitacea	N Cucurbitaceum
		PLURAL		
		Cucurbitacei	<b>Cucurbitaceae</b>	Cucurbitacea
(XVII)	Rosa (F) – rose		Rosaceus (Adj.) – rose-like	
	N O M	SINGULAR		
		M Rosaceus	F Rosacea	N Rosaceum
		PLURAL		
		Rosacei	<b>Rosaceae</b>	Rosacea

F = Feminine; M = Masculine; N = Neuter; NOM = Nominative. Forms adopted as family names are in bold letters.

It is obvious from preceding examples (*Table 1*) that Linnaeus and his successors preferred substantive (nominative) plural form of feminine adjective words to substantive plural form of nouns or masculine adjective words as family names. It is also seen (examples VIIb&c, IXb&c, XIII and XV) that choice of various adjectival forms of a word resulted in many different endings in a family name when such adjectival words were declined to substantive feminine plural forms. In short, while coining family names, botanists chose to add declined forms of different adjectival suffixes of their likings to the stem, *i.e.* basic part of a Latin word or generic name (obtained by removing the inflection from its genitive singular form). So, we find family names with varied endings at a later date.

**Rationalisation of Family Nomenclature:** The fact that no author has ever consistently followed any rule in naming such group and even some families have been known by two or more names in the published literature, a few leading nineteenth century botanists took the initiative to rationalize the confused state of family nomenclature. Among them, A.P. de Candolle ( *Theorie Elem.* 203.1813), while dealing with family nomenclature, felt that family names should be derived from an important included genus. He thus, accepted several such suffixes (de Candolle actually mentioned the corresponding French form of those Latin suffixes) in family names of earlier authors: –aceae, –arieae, –eae, –ineae, –aneae, –ideae, etc. Examples are Tiliaceae, Salicarieae, Menispermaceae, Cistaceae, Flacourtianaceae and Polymoniaceae. The choice of a particular suffix was left to euphony. He also favoured the usage of following few large, well established family names formed otherwise long ago: Compositae, Cruciferae, Gramineae, Guttiferae, Labiatae, Leguminosae, Palmae and Umbelliferae. Such diversity of termination for the groups of the same rank was found to be confusing. John Lindley (*Nat. Syst.* ed.2. p. XIII. 1836), therefore, ‘ventured upon a reformation of the nomenclature of the natural system, by making all the names of the divisions of the same value end in the same way’ in second edition<sup>6</sup> of his work - ‘An introduction to the natural system of Botany.....1830’, where he treated all the natural orders of the vegetable kingdom.

Accordingly, Lindley (*l.c.* 1836) not only adopted uniformly the suffix ‘–aceae’ for the names of the orders but also proposed therein several names ending in ‘–aceae’ for those orders for which such names were wanting. To make the transition, particularly of those eight well-established classical names of orders ending in ‘–ae’ to equivalent names ending in ‘–aceae’ a smooth affair, Lindley (*l.c.*, 1836, pp. 21, 58, 74, 148, etc.) mooted a novel way of presenting all such change-over (except Palmaceae). For example : order XI. Umbelliferae or Apiaceae, order XL. Cruciferae or Brassicaceae, order LV. Guttiferae or Clusiaceae, order CX. Leguminosae or Fabaceae, and the like. Though, thereby Lindley (*l.c.* 1836) heralded the inclusion of an unique exception in the botanical nomenclature – the provision for use of alternative names in specified cases, but this was not generally adopted until many years later.

Meanwhile, with the gradual recognition of more and more natural units between family and genus, and the usage of quite a few of such adjectival suffixes in providing suitable nomenclature to these units, there

<sup>6</sup> This edition was not only thoroughly revised with numerous additions and corrections but was also titled differently– A natural system of Botany..... ed.2. 1836.

was a marked shift in the preponderance of typified family names ending in *-aceae* and *-eae*. In fact, together with a few classical names ending with *-ae*, family/subfamily names ending in *-aceae* and *-eae* dominated 19th century taxonomic literature beginning with seventeen volume de Candolle, *Prodromus* (1824-1873) and ending in three volume Bentham & Hooker, *Genera Plantarum* (1862-1883). We also find that such a de Candollean provision for family names was also incorporated in Paris Code (1867).

The third International Botanical Congress (Vienna 1905, Code 1906) which for the first time gave serious consideration to nomenclatural matter, held that family names must be based on the name of an included genus with termination *-aceae*. But listed eight classical family names ending in *-ae* as exceptions (not based on generic names) owing to long usage (some of these were in use even in *Phil. Bot.* 27. 1751) and to be used in preference to equivalent names (based on a genus) ending in *-aceae*. The fourth International Botanical Congress (Brussels 1910, Code 1912) further specified similar use of termination *-oideae* to an included generic name for subfamilies. But unanimity in the uses of rules for family nomenclature was not achieved until these were ratified again in fifth International Botanical Congress (Cambridge, 1930, Code 1935). Here a significant change in the rules was introduced to usher uniformity in family nomenclature, which allowed the use of those eight classical names ending in *-ae* as well as their equivalent names (based on a genus) ending in *-aceae* as **alternative** names.

Even after the enactment of internationally agreed rules of nomenclature in the Cambridge Congress 1930 (Code, 1935), there was no uniformity in the application of family names in the botanical literature. Because of varied interpretation of rules, two or more names were in use even for the same family. For instance, Willow-herb family was named variously as Onagraceae, Oenotheraceae or Epilobiaceae, and the tea family was called Ternstroemaceae and Theaceae. To bring order to the usage of the family names and not to supersede the popular names purely on technical ground, the provision of *'Nomina Conservanda'* was therefore extended to include names of families in Montreal Congress (1959, Code 1961).

Botanical Code now has Articles 18 & 19 which deal with establishment of names of families and their subdivisions. It also includes provisions for regularization of illegitimate names through conservation, and correction of names published with improper termination or incorrectly designated ranks. Thus each of the eight family names which were not based on generic names has been provided with an *alternative* family name based on a genus. Accordingly each of the following descriptive families are presumed to be typified by the generic names of their respective alternative families/family names: Compositae (Asteraceae; type, *Aster* L.); Cruciferae (Brassicaceae; type, *Brassica* L.); Gramineae (Poaceae; type, *Poa* L.); Guttiferae (Clusiaceae; type, *Clusia* L.); Labiatae (Lamiaceae; type, *Lamium* L.); Leguminosae (Fabaceae; type, *Faba* Mill. [= *Vicia* L.]); Palmae (Arecaceae; type, *Areca* L.); Papilionaceae (Fabaceae; type, *Faba* Mill.); Umbelliferae (Apiaceae; type, *Apium* L.).

Furthermore, in view of the fact that most of the family names were formed in the past, a substantial number of those generic names on which these were based are no longer considered legitimate on nomenclatural motive. Accordingly, while the generic names *Caryophyllus* Mill. and *Wintera* Murray are illegitimate, the family names Caryophyllaceae and Winteraceae are legitimate because they have been conserved. Similar examples are Balsaminaceae, Ebenaceae, Lentibulariaceae, Onagraceae and Sapotaceae. One may find many such examples from the Appendix IIB of the Code. It may also be noted that although A.L. de Jussieu, *Genera Plantarum* (1789) has been taken as a starting point for listing of *'Nomina Familiarum Conservanda'*, except for a few adopted classical names, none of the family names was really published therein with the suffix *-aceae*.

#### FABACEAE VS. PAPILIONACEAE

It is true that there is a general confusion regarding the proper use of the names Fabaceae, Leguminosae and Papilionaceae. But much of this can be avoided if the underlying problems are properly understood. Unfortunately, it is not always clear to many that Code is not concerned with the circumscription of a taxon. On the other hand, an author is given a free hand to circumscribe a taxon according to his/her concept of the same. But once the taxon is circumscribed, the author is not given any free hand to name the same. The various provisions of the Code will then guide the author to select the correct name of the taxon with that particular circumscription, position and rank.



As is obvious, the problem with Leguminosae is typical. It is owing to the fact that there exists difference of opinion concerning the circumscription of the family: (i) It can be conceived as a 'single large conglomerate' or (ii) it can be split into three smaller but more natural, independent families. If one circumscribes the family as a single large conglomerate, then [as per the Botanical Code] the family has to be called either Leguminosae or Fabaceae. But, if the same taxon is considered as composed of 'three segregate families', then that one particular part may have to be called either Papilionaceae or Fabaceae.

As to other associated problems, it has been pointed out that, in the past, after enactment of rules of 'Names of families and subfamilies, tribes and subtribes' in Cambridge Code (1935), each of the eight conserved family names, which did not conform to this rule, have been provided with an alternative name (as per the enacted rule), either of which may be used. As a result *Faba* Mill., the type of the alternative family name Fabaceae is also presumed to be the type of both Leguminosae and Papilionaceae. This, however, created a new problem. The types of both Leguminosae and Papilionaceae being the same, these two are to be treated as synonymous. But because the well-established circumscription of these two traditional families is different, they have been conserved (not to destabilize such long usage of these two names). To overcome this anomalous situation, a provision has been embodied in the code which states that: "When the Papilionaceae are regarded as a family distinct from the remainder of Leguminosae, the name Papilionaceae is conserved against Leguminosae" despite the fact that their types being the same (*i.e.* *Faba* Mill.). Similarly, even though the subfamily name Papilionoideae is contrary to the rules, a unique exception is made in the Code, not to destabilize its long usage: "When Papilionaceae are included in the family Leguminosae as a subfamily, the name Papilionoideae may be used as alternative to Faboideae."

Conversely, the family names are unique in one feature, for, unlike the names at any other rank, the vast majority is conserved to maintain their use as though they are "protected names" rather than names conserved strictly for nomenclatural reasons (Hoogland & Reveal, 2005). To summarize, today only nine family names are descriptive in a sense that these are not based on generic names; all are conserved together with their appropriate alternative names (Article 18.5 & 18.6).

This provision in the Code has, however, become controversial in recent years. McNeil & Brummitt (2003), after analyzing relative frequency in their use in published literature, noted a growing preference for "-aceae" names with an unstoppable momentum; yet, for many compelling reasons, they did suggest a natural solution to the issue.

Since the Botanical Code aims at providing a stable method of naming taxonomic groups and keeping in view the ever-growing body of users of such names consists mostly of people who are not taxonomic experts, the well-established names formed in the past are not destabilized. Finally, it may also be noted again that 'Botanical Code' is not averse to modifications (as there is a clear provision) if better solution to the problems are proposed.

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## फेबेसी बनाम पेपिलिओनेसी के संदर्भ में कुछ विख्यात आवृतबीजी कुलों के लिए विकल्प नाम : ऐतिहासिक परिप्रेक्ष्य

आर.एल. मित्र, वी. एस. राजू एवं पी. सिंह

### सार संक्षेप

यह शोधपत्र एक प्राकृतिक इकाई के रूप में कुल संबंधी अवधारणा एवं उसके नामकरण के उत्स तथा विकास का ऐतिहासिक सारांश है। इसमें लैटिन व्याकरण की पृष्ठभूमि में वर्गीकरण (टेक्सोनोमिक) साहित्य में कुलों के नामकरण में विविध अंत वाले नामों की अतीत प्रधानता, वर्तमान में उनको युक्तिसंगत बनाने के तार्किक प्रयास, कुछ आवृतबीजी कुलों के लिए विकल्प नामों के प्रयोग के प्रावधान की व्याख्या भी है। इसमें लेग्युमिनोसे, फेबेसी एवं पेपिलिओनेसी नामों के समुचित प्रयोग एवं समवर्गी समस्याओं के विवेचन भी हैं।

**COMBRETUM TETRAGONOCARPUM KURZ VAR. TETRALOPHUM (C.B.CLARKE)  
M.GANGOP. & CHAKRAB. (COMBRETACEAE) – A NEW RECORD  
FOR INDIA FROM NICOBAR ISLANDS**

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The genus *Combretum* Loefl., comprises c. 250 species distributed throughout the tropics (excluding Australia) (Mabberley, 1997). In India, the genus is represented by 15 species (Gangopadhyay & Chakrabarty, 1997) of which, four taxa are reported from Andaman and Nicobar Islands (Ghosh, 1997; Gangopadhyay & Chakrabarty, *l.c.*; Ray, 1999). Subsequently, *Combretum sanjappae* has been described from North Andaman Islands (Chakrabarty & Lakra, 2002). While working on the 'Flora of Little Andaman Island', the authors came across few unidentified *Combretum* specimens deposited in the Botanical Survey of India regional herbarium, Port Blair (PBL). After critical study of the specimens with relevant literature, it was identified as *Combretum tetragonocarpum* Kurz var. *tetralophum* (C.B.Clarke) M.Gangop. & Chakrab., a taxon distributed in Thailand, Indo-China, Malay Peninsula, Java, Sumatra, Borneo and New Guinea and hitherto unknown to Indian flora. Hence, the same is reported here as a new addition to the Indian flora with full citation, description, phenology, distribution, ecology and specimens examined along with line drawing to facilitate further collection and identification.

**Combretum tetragonocarpum** Kurz var. **tetralophum** (C.B.Clarke) M.Gangop. & Chakrab. in J. Econ. Taxon. Bot. 17: 697. 1993. *Combretum tetralophum* C.B.Clarke in Hook.f., Fl. Brit. India 2: 454. 1878; King in J. Asiat. Soc. Bengal, Pt.2, Nat. Hist. 66(2): 336. 1897; Slooten, Bijdr. Combret. Flacourt. Ned.-Ind. 34. 1919 & in Bull. Jard. Bot. Buitenzorg III, 6: 54. 1924; Ridl., Fl. Mal. Pen. 1: 708. 1922; Exell in Steenis, Fl. Males. 1, 4: 541, fig.2. 1954; Nanakorn in Thai. Forest Bull., Bot. 16: 185, t. 79. 1986. Type: Malacca, Griffith KD 2195 (CAL), (K-n.v.). *Combretum* sp. *sensu* Thoth. & al. in Bull. Bot. Surv. India 15: 251. 1973 (1976). (Fig. 1).

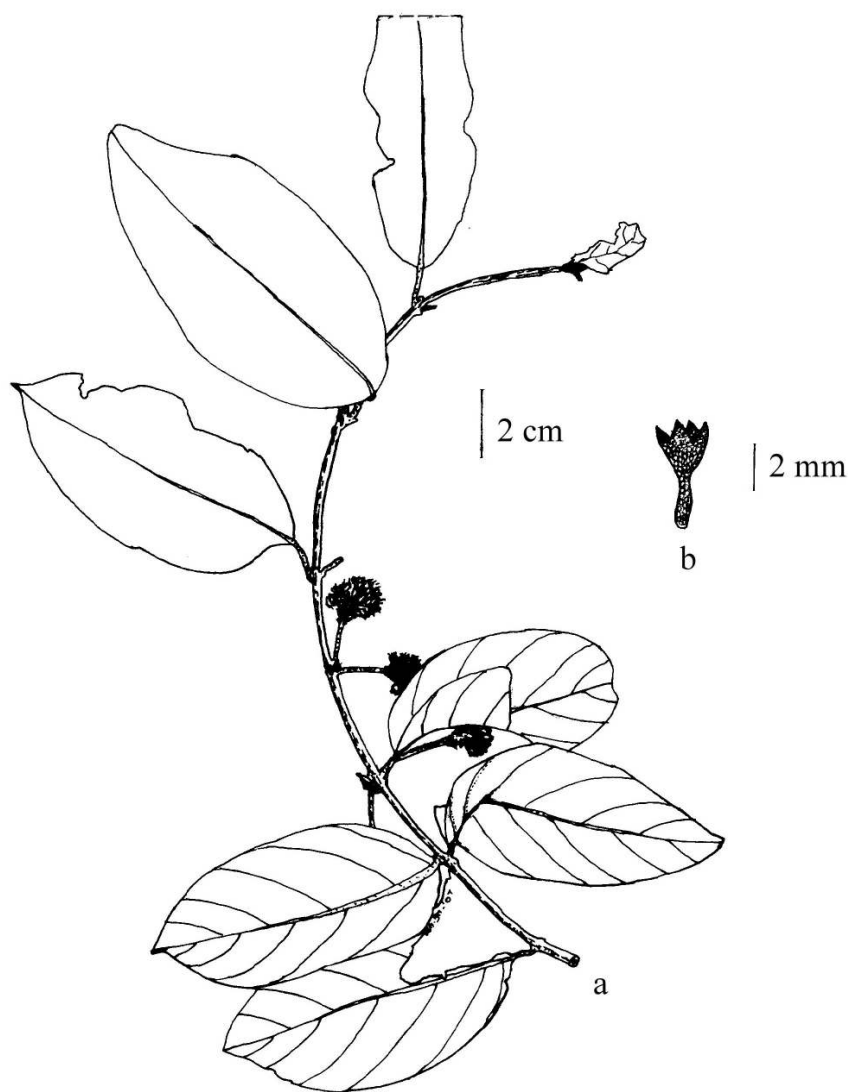
Climbing shrubs. Branchlets reddish-brown, terete, densely rusty tomentose when young, later glabrescent. Leaves opposite, simple, elliptic to ovate-elliptic, 6-11 × 3.5-5 cm, base cuneate or rounded, entire along margins, acute to shortly acuminate at apex, with a short mucro tip, membranous, dark brown, glabrous, occasionally scaly above, greenish-brown, glabrous, sparsely scaly beneath; midrib flat to prominulose above, prominently raised beneath, densely rusty tomentose on both sides; lateral nerves 7-9-pairs, faint above, prominent beneath; tertiary nerves scalariform; petioles up to 1 cm long, rusty tomentose. Inflorescences in axillary spikes and terminal panicles; spikes up to 3.5 cm long, subcapituliform; peduncles up to 2 cm long, rusty pubescent. Flowers greenish-white, sessile, 4-merous, c. 6 mm long. Receptacles cupuliform at apex, c. 2 × 3 mm, densely ferrugineous peltate scaly. Calyx lobes triangular, c. 1.5 mm long, acute, densely ferrugineous scaly. Petals 4, oblanceolate, up to 4 mm long, glabrous. Stamens 8; filaments up to 4 mm long. Disc densely barbate. Style c. 5.5 mm long.

*Fl.*: January - May.

*Distribution* : India: Andaman & Nicobar Islands; Thailand (Siam), Indo-China, Malay Peninsula, Sumatra, Java, Borneo, Celebes, New Guinea and Caroline Islands.

*Ecology* : Rare along the stream banks and road sides.

*Specimens examined* : North Nicobars, Katchal Island, Kapanga, 27-2-1977, P.Chakrabarty 5306 (PBL). South Nicobars, Great Nicobar Island, Dogmar river, 11-4-1966, Thothathri & Banerjee 11621 (PBL).



**Fig. 1(a & b).** *Combretum tetragonocarpum* Kurz var. *tetralophyum* (C.B.Clarke) MO. Gangop. & Chakrab.  
a. Flowering twig; b. Calyx.

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## NOTES ON RECOLLECTION OF THREE LESS KNOWN ENDEMIC PLANTS OF ARUNACHAL PRADESH

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During study of the specimens collected from the Kane Wild Life Sanctuary of West Siang district of Arunachal Pradesh, the first author collected three interesting specimens, which are identified as *Globba rubromaculata*, *Sonerilla arunachalensis* and *Sardiria erecta* var. *longipetiolata*. The Kane Wild Life Sanctuary lies between 94°55' - 94°63' between 27°33' - 28°35' and encompasses an area of 55 sq km in the Likabali forest range of Along forest division in West Siang district. The area is the entrance point to the state of Assam and comes under the tropical semi-evergreen forest type. The Sanctuary is bounded by Likabali forest range in three directions namely north, south and west and by the Dipa Forest range in the east. The boundary of the sanctuary is mainly determined by the two rivers 'Inche' and 'Inte' which flow around the sanctuary. The nearest approachable route to the sanctuary involves about 13 kms tough trekking towards the western direction from the main Likabali-Along state highway near 'Magge' village. The terrain is entire hilly, broken by three rivers, 'Ghai', 'Inche' and 'Inte'. The altitude of the area ranges between 250 - 650 msl. The flora of the Kane Wild Life Sanctuary is very luxuriant and shows a maximum diversity. On perusal of the available literature (Hajra & al. 1996; Chauhan 1997; Nayar & Sastry 1987, 1988, 1990, Nayar 1996) and herbarium specimens in ARUN, it revealed that all the three species are endemic to the state and have never been collected after the type collection. The type localities are different from the locality of the present collection. This collection other than the type locality confirms that the species has a wide distribution in Arunachal Pradesh in similar geographical locations and might be native to this region. These little known endemic species are described here with a short description emphasizing the differences with the original, critical field notes, associated species, and photo images for better understanding.

### 1. *Globba rubromaculata* J. Lal & D.M. Verma, Bull. Bot. Surv. India 29 (1-4): 26.1987.

Perennial herbs, 1-2.5 m high. Stem rounded, green. Leaves sessile, oblong or elliptic lanceolate, 17-28 × 4.5-7 cm, cuneate at base, entire, acuminate at apex, upper surface glaucous, minutely hairy beneath, ligules short, exceedingly hairy. Inflorescence a terminal raceme, peduncles 25-30 cm long, bracts early deciduous; peduncles puberulent or glabrous, lower part of the peduncles bearing bulbils; flowers saffron yellow, pedicels c.1cm long; calyx tubular, 3- toothed, c.1cm long; corolla tube slender, 1.5-2 cm long, lobes elliptic oblong, posterior lobe longer, lateral lobes included, concave and apiculate; lateral staminodes spatulate, c.5 mm long, lip inserted above the staminodes, deflexed, c.1cm long, deeply bilobed, conspicuous with two red blotches, filaments curved, 1-2 cm long, anthers not winged. Fruits subglobose, surface verrucose, c.1.5cm long, leathery. Seeds brownish, glabrous, suspended in gelatinous hyphae like mass.

*Notes:* The species is similar to the *Globba multiflora* Wall. ex Baker and distinguished from it by yellow saffron flowers with two red blotches in the lateral staminode. The present communication is supplemented by a photo of the flowers, fruits showing the clear verrucose nature, and bulbils in the lower part of the inflorescence, which are the most unique field characters for identification. In addition, this communication enriches the original description by providing the information on seeds, which is round and brown when young, and black on maturity. While going through the type specimens deposited at ARUN, it revealed that, the collections contained only immature fruit and seeds. The present collection is having a mature fruit as well as seed where the verrucose nature is clearly distinguished and the colour of the seeds can be distinctly seen. The size of the fruits in the present collection (S.S. Dash 32225; ARUN) is larger and differs from the type (Isotype: Itanagar, Ganga lake area, 450 m, J.Lal 2201B, in ARUN) and this may be attributed to the physical condition of the soil.

**2. *Sonerila arunachalensis*** G.S. Giri, A. Pramanik & H.J. Chowdhery, Ind. J. For. 15(1): 95-96.1992.

Small herbs, 10-20 cm high, stem terete, densely covered with spreading hairs. Leaves fascicled towards the apex, ovate to ovate-elliptic,  $2.5 \times 1.5$ -4 cm, cordate at base, serrulate at margin, ciliate with whitish hairs, acute at the apex, lateral veins 5-6 arises from the base, runs along the margin to reach apex, sparsely whitish hairy above, more dense along the veins beneath; petioles slender, easily breakable, densely covered by whitish hairs. Flowers in terminal scorpioid panicles, peduncles c.4cm long, covered by dense hairs. Flowers pink, subsessile, 4-7-flowered; calyx tube c.1.5 cm long, creamy white, whitish hairy outside, sepals 3, triangular ovate; petals 3, ovate-oblong,  $0.7$ - $1.1 \times 0.4$ - $0.7$  cm, with a band of hair on the midrib, mid-rib depressed; stamens 3, filaments filiform, 5-7 mm long, anthers sickle shaped, attenuate at both the ends, stigma capitate.

*Notes:* The species was described by Giri & al. (1992) based upon a collection from Mehao Wild Life Sanctuary of Dibang Valley district {Mehao Wild Life Sanctuary, 1500, 15.9.90. A. Pramanik 5438 (ARUN) Isotype}. The present collection from the Kane Wild Life Sanctuary, S.S.Dash 32062 (ARUN) is the first recollection after the type and from a different locality at an altitude of 700 msl. The paratype (G. Panigrahi 14973 in CAL) is collected from Wakka forest area (27th Aug. 1958) of Lower Subansiri district of Arunachal Pradesh. The species is easily recognized in the field by the presence of pink flowers, sickle shaped anthers in filiform filaments and presence of whitish hairs throughout. The present collection differs from the type collection by the presence of white ferruginous hairs (brown hairs in the protologue). The presence of ferruginous hairs throughout the plant is the main distinguishing character to delimit the allied species viz. *Sonerila maculata* Roxb. and *Sonerila khasiana* C.B. Clarke which are also expected to occur in this region.

**3. *Sadiria erecta*** (C.B.Clarke) Mez, var. ***longipetiolata*** G.S. Giri, G.D. Pal & H.J. Chowdhery, Ind. J. For. 15(1): 95-96.1992.

Erect shrubs, up to 1.5 m high, branches terete, grayish. Leaves alternate, elliptic lanceolate or oblong-lanceolate,  $7$ - $14 \times 3$ - $5$  cm, cuneate at base to a decurrent petiole, crenate-dentate at margin, midveins raised, lateral veins c.18 pairs, reaching to the margins, reticulation conspicuous beneath, glabrous above and minutely rusty pubescent beneath, petioles 1-1.5 cm long. Inflorescence axillary panicles umbellate, peduncles c.1.5 cm long; bracts ovate-lanceolate, acute at apex; calyx segments 5, lanceolate, acute at apex, c.  $2 \times 0.7$  mm, glabrous; corolla tubular, c. 2 mm long, lobes ovate or ovate-lanceolate, acute, whitish; stamens 5, sessile, attached at the base, filaments glabrous, anthers gland dotted; ovary ovoid or globose.

*Notes:* This new variety was described from the collection of A.R.K. Sastry from Amjee locality, (8 km from Begi) in the Lower Subansiri district of Arunachal Pradesh at an altitude of 1400-1500 m. The present collection (S.S.Dash 32137 in ARUN) is the first report of recollection of the variety after the type collection in 1964 after a gap of 45 years from the Kane Wild Life Sanctuary of West Siang district. The plant is rarely found in the moist and shady localities in a mountain cliff along the 'Inte' river. The species is easily recognized by its raised dentate margin and peculiar lateral veins.

It is interesting to observe that, all the above endemic species were found in the same locality i.e. Kane Wild Life Sanctuary. Collection of these endemic species from the sanctuary confirms that the area might be supported by many endemic and rare plants that have survived due to protective natural barriers.

*Biotic association :* Trees like *Castanopsis indica* (Roxb.) A. DC., *Ditperocarpus retusus* Bl., *Elaeocarpus* sp., *Gynocardia odorata* R. Br., *Knema angustifolia* (Roxb.) Warb., *Litsea monopetala* Pers., *Phoebe lanceolata* Nees, *Saurauia napaulensis* DC., *Styrax serrulatum* Roxb., *Terminalia myriocarpa* Heurck & Muell.- Arg. *Trevesia palmata* (Roxb.) Vis. are the common trees found in the locality. The main shrubby elements found in the locality are *Boehmeria macrophylla* D.Don, *Chloranthus elatior* R. Br. ex Link, *Debregasia longifolia* (Burm.f.) Wedd., *Maesa indica* (Roxb.) Wall., *Meyna spinosa* Roxb. ex Link. *Micromelum integerrimum* (Roxb.) Roem, and *Morinda angustifolia* Roxb., *Mussanda incana* Wallich, *Oxyspora paniculata* DC., *Pseudobrassiaopsis hispida* (Seem.) R.N.Banerjee, and *Osbeckia nepalensis* Hook. The association in the ground flora forms the main group for these endemic plants. The important associated ground vegetation found around the collected localities are *Amisotolype mollissima* (Blume) Hassk., *Chirita macrophylla* Wallich, *Hedyotis verticillata* (L.) Lam., *Poikilospermum naucleiflorum* (Roxb.) Chew, *Polia hassakarlii* R. Rao, and *Rhynchoglossum obliquum* Blume While the



Flowers of *Globba rubromaculata* J.Lal & D.M.Verma showing two red blotches in the lateral staminodes.



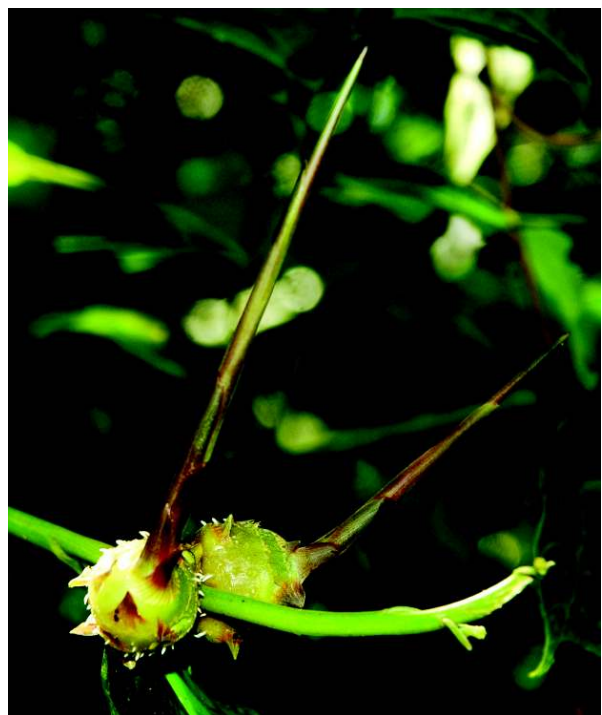
Flowers of *Sonerila arunachalensis*  
G.S. Giri, A. Pramanik & H.J. Chowdhery



*Globba rubromaculata* J.Lal & D.M.Verma



*Globba rubromaculata* J.Lal & D.M.Verma : fruits



*Globba rubromaculata* J.Lal & D.M.Verma :  
showing germinated bulbils



*Sonerila arunachalensis*  
G.S. Giri, A. Pramanik & H.J. Chowdhery

main epiphytic plant found are *Aeschynanthus bracteatus* Wallich, *Agapetes incurvata* (Griff.) Sleumer, *Rhaphidophora hookeri* Schott.

#### ACKNOWLEDGEMENTS

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## THE ENDEMIC AND RARE *NOTOTHYLAS ANAPORATA* UDAR & D.K. SINGH (NOTOTHYLACEAE: ANTHOCEROTAE) REDISCOVERED

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Udar and Singh (1979) described *Notothylas anaporata* as a new species and holotypified the name on a Pandé material collected from Khandala in the Western Ghats of Maharashtra. In his regional monograph on the Notothylaceae, represented by the lone genus *Notothylas*, Singh (2002) included 11 species. Of these, 9 including *N. anaporata* are endemic. In the protologue of *N. anaporata* Udar and Singh (1979) cited only one specimen (holotype). However, Singh (2002) included another specimen as well which was also collected by Pandé in Khandala (S.K. Pandé 489 R/WG, Nov. 1955, LWU). Singh (2002) categorically stated that *N. anaporata* is extremely rare. It was earlier known by only two collections. *Notothylas anaporata* has been now collected in the Shendurney Wildlife Sanctuary in the southern Western Ghats which is more than 1000 km away from the type locality. Khandala in the northern Western Ghats is a low rainfall, low humidity and high temperature region when compared to the Shendurney Wildlife Sanctuary. Now that *N. anaporata* has been collected at the other end of the Western Ghats with a totally different environment, it is likely to occur in the intervening regions. Hence, a detailed description and photographs are provided to help find the species elsewhere in the Western Ghats. Specimen cited is deposited at SCCN (herbarium of Scott Christian College, Nagercoil).

**Notothylas anaporata** Udar & D.K. Singh, Rev. Bryol. Lichénol. 45: 202. 1979; A.K. Asthana & S.C. Srivast., Bryophyt. Biblioth. 42: 98, t. 22, ff. 1 - 10 & t. 44, ff. 1 - 3. 1991; Bapna & Kachroo, Hepatic. India 1: 206. 2000; D.K. Singh, Notothylac. India: 68, tt. 17 - 21. 2002. - Type: India, Maharashtra, W. Ghats, Khandala, c. 500 m, Nov. 1955, S.K. Pandé WG 500 (holotype LWU). (**Plate 1**).

Plants in isolated patches. Thalli 6 - 8 × 3 - 4.5 mm, crenulate to lobed at margin; epidermal cells 80 - 120 × 40 - 80 µm, with a single quadrate-hexagonal chloroplast and a distinct, granular, pyrenoid region. Thalli c. 0.8 × 0.4 mm in cross section, 4 - 6-layered in middle, without mucilage cavities. Rhizoids smooth-walled. Involucre 4-plicate at apex, c. 2.75 × 1.5 mm. Sporogonia c. 3 × 1.5 mm, submarginal, inclined, extending beyond thallus margin, nonstomatiferous; capsule outer wall cells quadrate-rectangular, reddish brown; inner wall cells subquadrate, pale brown with distinct dark brown, transverse to spiral (- semiannular) thickening bands; columella distinct, persistent, purplish brown. Spores 36 - 40 × c. 36 µm, ovoid, granular, with a large copular, circular to semicircular protuberance, dark brown to black with distinct triradiate mark almost reaching periphery. Pseudo-elaters 40 - 80 × 28 - 40 µm, variously shaped, 1-celled, thin-walled with transverse to spiral (- annular) thickening bands, pale purple-brown.

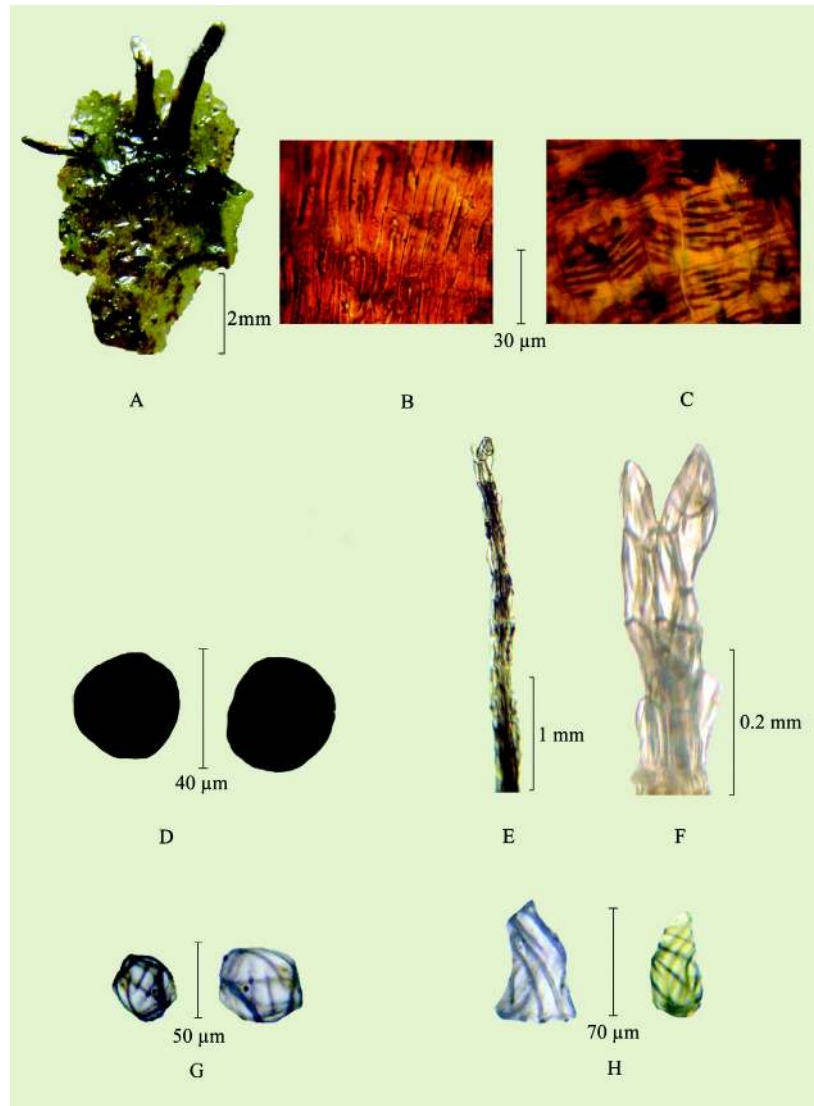
*Habitat:* Terricolous on red soil, on roadsides, in shade under fallen log, in degraded evergreen forests, at c. 500 m.

*Distribution:* India: Maharashtra (Khandala) and Kerala (W. Ghats of Kollam), endemic.

*Specimen examined:* Kerala, Kollam dist., W. Ghats, Shendurney Wildlife Sanctuary, on the way to Palaruvi, c. 500 m, 22.12.2008, *Felix* 544.

### ACKNOWLEDGEMENTS

We thank the Kerala State Forest Department for permission to explore the area in question and help in the field, Dr. P. Daniel, formerly Joint Director, BSI, Coimbatore, for his constructive criticism on the original manuscript and Dr. S.C. Rose, Principal, Scott Christian College, Nagercoil, for encouragement. The financial support provided by the Ministry of Environment & Forests, New Delhi through the AICOPTAX project is gratefully acknowledged.



**Plate 1:** *Notothylas anaporata* Udar & D. K. Singh : A. Plant; B. Capsule outer wall; C. Inner wall; D. Spores (outer & inner faces); E & F. Columella; G & H. Pseudo-elaters (photographed from *Felix* 544).

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## LESS KNOWN ETHNIC USES OF PLANTS OF SOUTH SIKKIM

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The present paper deals with the less known ethnic uses of 14 angiosperm & recorded during floristic exploration of Tendong Reserve Forest and its surrounding areas of south district of Sikkim. Sikkim (27°05' - 28°08' N and 88°0'58" - 88°55'25"E), a small state located in Eastern Himalaya with only 0.2% of the geographical area (7096 sq km) of the country, harbours c.5000 species of flowering plants including numerous endemics and potentially useful plants. During 2003 - 2006, botanical exploration of Tendong Reserve Forest (South Sikkim) was taken up and efforts were made to record the traditional uses of plants as practiced by the ethnic communities like Lepchas, Bhutias, rural Nepalese, etc. residing in remote pockets, villages and valleys of south district. The data on uses have been recorded with the help of local medicinal practitioners, traditional healers and as observed in the field. These ethnobotanical data on comparison with relevant literature (Ambasta, 1986; Jain, 1991; Kirtikar & Basu, 1935; Wealth of India 1952-73) have been found to be of less known or new uses. The voucher specimens collected during the field tours have been documented as herbarium specimens and are deposited in the herbarium of Botanical Survey of India, Sikkim Himalayan Circle, Gangtok (BSHC). For collector's name please read A.K. Sahoo. Herbarium specimens of the other collector, if any, in BSHC have been specified. The species recorded for less known ethnic uses are *Dichroa febrifuga* Lour. "Basak" (Stem bark extract to reduce fever), *Geranium nepalense* Sweet (Plant extract to cure Dysuria), *Hemiphragma heterophyllum* Wall. "Malajhar" (Raw fruits and leaves to cure Dyspepsia), *Holboellia latifolia* Wall. "Bagul" (Ripe fruit, pulp to cure Dyspepsia), *Houttuynia cordata* Thunb. (Green leaves to recover from weakness and for healing wounds), *Hydrangea aspera* D. Don ssp. *robusta* (Hook. f. & Thoms.) Mc Clintock (Leaf and root extract to reduce Fever), *Lyonia ovalifolia* Wall. (Young leaf exudates to cure Blisters), *Mahonia napaulensis* DC. "Kesri" (Inflorescence extract to cure Diarrhoea and stem pith to cure Jaundice), *Parochetus communis* Buch.-Ham. ex D. Don (Young leaf extract to cure Flatulence of baby), *Peperomia heyneana* Miq. (Inflorescence extract to cure Cough & Cold), *Pratia nummularia* (Lam.) A. Br. & Aschrs., (Fruit and young leaf extract to cure Asthma), *Rhododendron arboreum* Smith "Guras" (Dried flower dust to cure Dysentery), *Rubia manjith* Roxb. ex Fleming "Manjito" (Root extract to cure Diarrhoea) and *Rumex nepalensis* Spreng. "Halhale" (Leaf paste to relieve Muscular pain).

## ENUMERATION

**1. *Dichroa febrifuga*** Lour. in Fl. Cochinch. 1:301. 1970; C.B. Clarke in Hook. f., Fl. Brit. India 2:406. 1878. (Hydrangeaceae). "Basak".

*Fl. & Fr.* : Apr.-Aug.; Common (20385).

*Distribution* : India (N.E. States, Assam, Meghalaya, Sikkim), Nepal, Bhutan, Myanmar, Eastern Central China, Taiwan and Malaysia at 1000 - 2800 m.

*Uses* : Stem bark is crushed and made into paste in water is given orally to reduce high fever. It is given thrice a day for 3 days for complete cure of fever. The fresh preparation of drug for each dose is effective. This is used to cure malaria (Kirtikar & Basu, 1935).

**2. *Geranium nepalense*** Sweet, Geraniaceae 1:t. 12. 1820; Edgew. in Hook. f. Fl. Brit. India 1:430. 1874; Malhotra in Fl. India 4:75. 1993. (Geraniaceae).

*Fl. & Fr.*: June - Aug.; Uncommon (26302).

*Distribution* : India (Eastern Himalaya & Sikkim), Afghanistan, Tibet, Myanmar, China and Nepal at 2000 - 3000 m.

*Uses* : Fresh plant extract in water is given twice daily in the morning and evening to cure Dysuria. Fresh prepared drug is given for two weeks for complete cure. This is used in renal complaints (Ambasta, 1986).

**3. Hemiphragma heterophyllum** Wall. in Trans Linn. Soc. 13:612. 1822; Hook. f., Fl. Brit. India 4:289. 1884; Burkill in Rec. Bot. Surv. India 4:123. 1910. (Scrophulariaceae). “*Malajhar*”.

*Distribution* : India (Garhwal Himalaya, Assam and Sikkim), Bhutan, Nepal, Myanmar, China, Taiwan and Philippines at 1800 - 3600 m.

*Fl. & Fr.*: Apr.-Aug.; Common (26415).

*Uses* : Rawfruits (8-10) and fresh leaves (3 - 4) are chewed and the juice taken in morning and evening to cure throat infection, Tonsillitis, cough and cold. It is continued for a couple of days for complete cure. This is a new use & not recorded earlier.

**4. Holboellia latifolia** Wall. Tent. Fl. Nepal. 24. t. 16. 1824; Hook. f. & Thom. in Hook. f. Fl. Brit. India 1:108. 1872; Nayar & Paul in Fl. India 1:423. 1993. (Lardizabalaceae). “*Bagul*”.

*Fl. & Fr.* : Feb.-July; Uncommon (26436).

*Distribution* : India (E. Himalayas, Kumaon Himalaya and Sikkim) Myanmar, China and Nepal at 1500 - 4000 m.

*Uses* : Ripe fruit pulp is taken in morning to cure Dyspepsia and Flatulence. It is taken initially for one week or may be extended few more days, if required. This is a new use & not recorded earlier.

**5. Houttuynia cordata** Thunb. in Vet. Akad. Stockh. Handl. 4:149, t. 5. 1783; Hook. f., Fl. Brit. India 5:78. 1886. (Saururaceae). “*Rakatejhar*”.

*Fl. & Fr.* : May-Sept.; Common (26308).

*Distribution* : India (Himachal Pradesh, Punjab Himalaya and Sikkim) Thailand, China, Japan, Myanmar, Nepal and Tibet at 1500 - 4000 m.

*Uses* : i. Green leaves are boiled or fried and eaten to regain physical strength after illness and Weakness.

This a new use & not recorded earlier.

ii. Paste or crushed green leaves applied on Cuts and Wounds for healing. It is applied once in a day for a week for complete cure. This is a new use & not recorded earlier.

**6. Hydrangea aspera** D. Don subsp. **robusta** (Hook. f. & Thoms.) Mc Clintock in J. Arn. Arb. 37:373. 1956. *Hydrangea robusta* Hook. f. & Thoms. in J. Linn. Soc. Bot. 2:76. 1857; C.B. Clarke in Hook. f. Fl. Brit. India 2:404. 1878. (Hydrangeaceae).

*Fl. & Fr.*: Apr.-Aug.; Uncommon (96531).

*Distribution* : India (Kumaon Himalaya and Sikkim) Nepal, N. Myanmar, China and Bhutan at 1800-2700 m.

*Uses* : Fresh leaves and roots are crushed in water and the extract is given four times a day to cure fever. It is continued with fresh preparation for 4 days to cure. This is a new use & not recorded earlier.

**7. Lyonia ovalifolia** (Wall.) Drude in Engler & Prantl. Pflanzenfam. 4(1): 44. 1889. *Andromeda ovalifolia* Wall. in Asiat. Res. 13:391. 1820. *Pieris ovalifolia* (Wall.) D. Don in Edinb. Phil. J. 17:159. 1834; C.B. Clarke in Hook. f., Fl. Brit. India 3:460. 1882. (Ericaceae).

*Fl. & Fr.*: Apr.-Aug.; Uncommon (23601).

*Distribution* : India (Assam, Punjab Himalaya and Sikkim), Pakistan, Nepal, Myanmar, China, Malaya Peninsula, Tibet and Bhutan at 1500 - 3000 m.

*Uses* : Exudate of young leaves (after plucking) is directly applied 3 - 4 times a day on the affected portion of skin to cure Blisters. The blisters are curable in 3 - 4 days. This is a new use & not recorded earlier.

**8. Mahonia napaulensis** DC., Syst. Nat. 2:21. 1821 & Prodr. 1:109. 1824. *Berberis nepalensis* (DC.) Spreng., Sys. Veg. 2:120. 1825; Hook. f., & Thom. in Hook. f., Fl. Brit. India 1:109. 1872, *p.p.*; Guhabakshi in Fl. India 1:41. 1993. (Berberidaceae). “*Kesri*”.

*Fl. & Fr.* : Jan.-June; Common (26653).

*Distribution* : India (Eastern Himalaya and Sikkim), Nepal and Bhutan at 2000 - 2900 m.

*Uses* : All the uses recorded are new.

- i. Young inflorescence is made into pickle and eaten.
- ii. Inflorescence is crushed and the extract is taken to cure Diarrhoea. This is taken twice a day for two days to cure.
- iii. Pith of old stem is crushed and made into paste in water. The juice extract thus obtained is taken 3 times a day for one week to cure Jaundice.

**9. *Parochetus communis*** Buch.-Ham. ex D. Don in Prodr., Fl. Nepal. 240. 1825; Baker in Hook. f. Fl. Brit. India 2:86. 1876. (Fabaceae).

*Fl. & Fr.*: Apr.-Aug.; Common (26438).

*Distribution* : India (Himachal Pradesh & Sikkim), Nepal, Africa and continental Asia at 1000 - 4300 m.

*Uses* : Young leaves are crushed and the juice extract is given as a baby tonic to cure Flatulence. The extract is given daily before feeding the baby and continued for two weeks to cure. It is reported in N.E. India, i.e. Meghalaya (Jain 1991) and is a new use record for Sikkim.

**10. *Peperomia heyneana*** Miq. in Syst. 123. 1845. *p.p.*; Hook. f., Fl. Brit. India 5:99. 1886.

*Fl. & Fr.*: Apr.-Aug.; Uncommon (26461).

*Distribution* : India (Kumaon and Sikkim Himalaya), Bhutan and Nepal at 2000 - 3000 m.

*Uses* : A bunch of inflorescence is crushed in water and the juice extract is taken to cure Cough & Cold. It is taken twice a day and continued for 4 - 5 days to cure. This is a new use & not recorded earlier.

**11. *Pratia nummularia*** (Lam.) A. Br. & Aschrs. in Ind. Sem. H. Beral 1861. app. 6. 1861. *Lobelia nummularia* Lam., Encycl. 3:589. 1791. *Pratia begonifolia* (Wall.) Lindl. in Bot. Reg. 16. t. 1373. 1830; C.B. Clarke in Hook. f., Fl. Brit. India 3:422. 1881. (Lobeliaceae).

*Fl. & Fr.*: Apr.-Aug.; Uncommon (26544).

*Distribution* : India (Assam, Eastern Himalaya and Sikkim), China, Nepal, Malaysia and Myanmar at 2000 - 3000 m.

*Uses* : Fruits (10-15) and young leaves (5-10) are crushed and the extract is given orally to cure Asthma. It is given twice a day for two weeks. Fresh preparation of extract is always effective. This is reported earlier (Wealth of India 1973).

**12. *Rhododendron arboreum*** Smith in Exot. Bot. 1:9. t. 6. 1805; C.B. Clarke in Hook. f. Fl. Brit. India 3:465. 1882. (Ericaceae). "*Laligurash*".

*Fl. & Fr.*: Jan.-May; Common (29546).

*Distribution* : India (Kashmir Himalays, Eastern Himalaya, Arunachal Pradesh and Sikkim), Pakistan, Sri Lanka, Nepal, Myanmar & South Tibet at 1500 - 3500 m.

*Uses* : Fresh powder prepared by crushing the dried flowers is given to cure Dysentery. It is given four times a day and dysentery is checked in two days. The fresh preparation is much effective. This use is recorded earlier (Ambasta, 1986).

**13. *Rubia manjith*** Roxb. ex Fleming in As. Res. 11:177. 1810. *R. cordifolia auct. non L.*, D. Don Prodr. Fl. Nepal. 133. 1825; Hook. f. Fl. Brit. India 3:202. 1881. (Rubiaceae). "*Manjitho*".

*Fl. & Fr.*: Apr.-Aug.; Common (26645).

*Distribution* : India (Himachal Pradesh, Eastern Himalaya and Sikkim) Pakistan, Nepal, Bhutan and Tibet at 1000 - 2700 m.

*Uses* : i. Dried root are crushed in water and the extract is given thrice a day to cure Diarrhoea. it is continued for three days to cure. This use is recorded earlier (Ambasta, 1986).

ii. The plant yields dye and it is commercially used for dyeing. It is recorded earlier (Wealth of India, 1972).

**14. *Rumex nepalensis*** Spreng. in Syst. Veg. 2:159. 1825; Hook. f., Fl. Brit. India 5:60. 1886. (Polygonaceae). "*Halhale*".

*Distribution* : India (Eastern Himalayas and Sikkim) Afghanistan, Nepal, China, Java and Europe at 1200-4500 m.

*Fl. & Fr.*: Apr.-Aug.; Common (26451).

*Uses* : Fresh leaves are crushed and made into paste which is massaged twice a day on affected portion of body to get relief of Muscular pain. It is continued to about a week for complete cure. This is reported earlier (Jain, 1991).

#### CONSERVATION STRATEGIES

An analysis on ethnobotanical uses reveal that while single species of *Geranium nepalense*, *Lyonia ovalifolia* and *Pratia nummularia* are used to cure dysuria, blisters and asthma; two or more species *i.e.* *Dichroa febrifuga*, *Hydrangea aspera* var. *robusta* are used to reduce fever; *Hemiphragma hetrophyllum* and *Peperomia heyneana* to cure tonsillitis and cough; *Holboellia latifolia* and *Parochetus communis* to cure dyspepsia and flatulence; *Houttyunia cordata* and *Rumex nepalensis* to recover from weakness and muscular pain; as well as *Mahonia napaulensis*, *Rubia manjith* and *Rhododendron arboreum* to cure diarrhoea and dysentery. The plant resources in wild habitat maintains the gene pool of a particular species. The genetic resources sometimes treated as standardized material to monitor the plant variants. The species and generic diversity either in original habitat (*in-situ*) or in specially designed facilities out side natural habitat (*ex-situ*) by establishing botanic gardens are required to be maintained in an ecosystem for future reference material. The collection of rare and endangered species of medicinal plants from wild must be restricted and discouraged. Such plants should be cultivated in their areas of occurrence and nearby localities. Judicious collection of other medicinal plants from wild must be regulated and monitored. Efforts should be made to cultivate these plants.

#### ACKNOWLEDGEMENTS

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## ON THE CORRECT IDENTITY OF WESTERN HIMALAYAN *PLAGIOGYRIA* (KUNZE) METT.

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*Plagiogyria* (Kunze) Mett., the only genus of family Plagiogyriaceae (Pteridophyta), is represented by about 15 species (Smith & al., 2006) which are mainly confined to China and neighboring countries in S. E. Asia, with one species reported from America (Hooker 1860, Zhang and Nooteboom 1998). There is no general consent about the number of species in India. Beddome (1883) described only four species of this monophyletic genus (Korall & al. 2006) from India, but during course of time, the number of Indian species raised up to sixteen (Dixit 1984, Chandra 2000, Dixit & Das 1981, Ghosh & al. 2004). However, recently Fraser Jenkins (1997, 2008) retained the number of species to only four following Beddome (1883) and Zhang & Nooteboom (1998). The three species i.e. *P. pycnophylla* (Kunze) Mett., *P. adnata* (Blume) Beddome and *P. glauca* Mett., were well described by Beddome (1883), where he correctly mentioned the paripinnate lamina apex. Besides that, he also separated them with diagnostic features as *P. adnata* with adnate pinnae and winged rachis and *P. glauca* with white glaucous lamina undersurface. But he did not mention the imparipinnate character of fourth species i.e. *P. euphlebia* (Kunze) Mett.; Nevertheless this character of distinction between *P. euphlebia* and *P. pycnophylla* was clearly mentioned by Hooker (1860) and Iwatsuki (1988) for the Himalayan plants.

Based on the collection of Dr. H. C. Pande, Khullar (1994) reported *Plagiogyria scandens* from Kumaon and the same name was also followed by Pande and Pande (2002, 2003). At present in Kumaon the plant is found growing in only two small stream gullies below District Institute of Education and Training (DIET) to Hat village in Didihat town of Pithoragarh district, Uttarakhand, from where few more interesting and rare ferns of Western Himalaya viz. *Diplazium subsinuatum*, *Colysis insignis*, *Arachniodes aristata*, *Dennstaedtia scabra*, *Microlepia platyphylla*, *Christella papilio*, *Osmunda japonica* along with dozens of common ferns are collected by the present author (Kholia and Punetha 2002, 2003). The silhouette published by Khullar was without apical pinnae but on the careful observation in field as well as on the basis of literature trawl on Kumaon plant, it is concluded that the plant growing in Didihat (Pithoragarh, Below Normal School, 27.09.1998, 29°47'38"N, 80°15'41"E, B.S. Kholia-19984, 19986, 19987, deposited in Kumaon Univ. Herbarium) is *Plagiogyria euphlebia* (Fig. 1) with imparipinnate lamina apex instead of *Plagiogyria scandens* which is a synonym of common Western Himalaya peripinnate fern *Plagiogyria pycnophylla*.



**Fig. 1.** *Plagiogyria euphlebia* (Kunze) Mett. growing at Didihat.

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## PHALLUS CALONGEI G. MORENO & KHALID – A NEW RECORD FOR INDIA

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The state of Sikkim exhibits enormous variability of biological resources including macrofungi (Das 2009), due to its altitudinal and climatic variations. During a macrofungal survey and collection tour to Khangchendzonga Biosphere Reserve in Sikkim, the senior author came across *Phallus calongei* which after thorough study and literature survey appeared a new record for Indian mycoflora.

Macro-morphological characters were noted from the fresh samples in the field. Micro-morphological characters were studied with dry materials mounted in 5% KOH, Lactophenol Cotton Blue, Distilled water and 30% Glycerol. Colour codes and terms mentioned are after Kornerup & Wancher (1981). Micro-photograph was taken with the aid of Olympus CX-41 fitted with digital camera E-410 at original magnification of 1000x for basidiospores. For measuring basidiospores, 25 basidiospores were observed. Quotient ( $Q = L/W$ ) was calculated considering the value of length (L) and width (W). Herbarium name used is after Holmgren & al. (1990).

**Phallus calongei** G. Moreno & Khalid, Mycotaxon 108: 458. 2009. (Fig.1).

Unexpanded basidiomata (egg) 30-48 × 28-40 mm, globose to ovoid, chalky (A1), rhizomorph white (A1), branched. Exoperidium thin, membranous, chalky (A1); mesoperidium gelatinous, hyaline; endoperidium chalky (A1); gleba olive yellow (2C8, 2D7, 2D8, 3D7 or 3D8) surrounding the unexpanded orange white (5A2 to 6A2) stalk that develops as a pseudostipe with maturity. Pseudostipe in a fully expanded basidiomata 140 - 230 × 20 - 38 mm, cylindrical, gradually broader towards base, with perforated truncate apex, hollow, spongy, white (A1) to reddish white (7A2). Receptacle (pileus) conical to campanulate, 35-60 mm high, 30-50 mm wide at base, surface coarsely reticulate with strong ridges and pits, mostly light orange (5A4), pale orange (6A3), salmon (6A4) or paler to reddish white (7A2 or 8A2) and white (A1) at the wider base. Indusium poorly developed on the pseudostipe (near apex) beneath the receptacle, expanded up to 3/4th of the receptacle length, white (A1), membranous. Gleba gelatinous, olive brown (4D8), golden brown (4D7), olive yellow (3D8) or golden (4C6). Volva (around the pseudostipe-base) 40-55 × 30-43 mm, white (A1) to orange white (5A2 or 6A2). Odour foetid and disagreeable, detectable 10-12 meters away.

Basidiospores 2.8 - 4 × 1.2 - 2 µm ( $Q = 1.6 - 2.5$ ), ellipsoid, elongate or cylindric, smooth, hyaline. Indusium never pseudoparenchymatous, composed of intermixed, hyphae; hyphae up to 5 µm broad, branched, septate.

*Habitat:* Gregarius to caespitose, growing on decaying or decomposed wood in the temperate (2572 m) mixed forests.

*Specimen examined:* India, Sikkim, Bakhim, N 27° 25' 40.8", E 88° 11' 20.8'', 2572 - 2600 m msl., leg. K. Das 28.08.2009, KD-1219 (BSHC 41082, SFSU).

*Notes:* Present taxon belongs to the family Phallaceae (Kirk & al. 2008) and can easily be distinguished in the field by the white egg, coarsely reticulate salmon to pale orange receptacle, presence of poorly developed indusium which is never pseudoparenchymatous and the habitat as decomposed wood. The Holotype differs from the Indian material by absence of indusium beneath the receptacle of basidiomata (Moreno, Khalid & Alvarado 2009). Other species growing on wood i.e. *Phallus pygmaeus* Baseia, *P. minusculus* Kreisel & Calonge, *P. tenuis* (E. Fisch.) Kuntze can be separated from this species in discussion by having smaller pseudostipe (Calonge 2005). Further, *P. pygmaeus* has smooth receptacle and reticulate pseudostipe whereas, *P. tenuis* has yellow pseudostipe.



**Fig. 1:** *Phallus calongei* G. Moreno & Khalid: a. A colony with several basidiomata; b. Unexpanded basidiomata (egg); c. Indusium beneath the receptacle; d. Receptacle; e. Unexpanded and expanded basidiomata; f. Basidiospores. Bar = 20 µm.

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## THREE NEW COMBINATIONS IN *PHOTINIA ARGUTA* LINDL. (ROSACEAE)

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*Photinia* Lindl. (1821) a Rosaceous genus was treated conspecific with *Pourthiaea* Decne. (1874) by J. Vidal in 1965 and C. Kalkman in 1973 in their revisionary studies on Asiatic species and Malesian species of *Photinia* Lindl., respectively. J.D. Hooker in Flora of British India (1878) treated the genus *Pourthiaea* Decne. (1874) as a separate and good genus with one species *arguta* Decne., describing 6 new varieties under it. Vidal (1965) transferred var. *hookeri* Decne., and var. *salicifolia* Decne., to the genus *Photinia* Lindl. and var. *wallichii* Hook. f., was made synonymous to *Photinia arguta* Lindl. Here in this paper the var. *membranacea* Hook. f., var. *parvifolia* Hook. f. and var. *latifolia* Hook. f., are transferred to *Photinia arguta* Lindl., of which the former two are restricted to India (Meghalaya region) only and the last one to Myanmar and Meghalaya (India).

***Photinia arguta*** Lindl., Bot. Reg. 23: t. 1956. 1837; Vidal in Adansonia 5: 228. 1965; Balakrishnan, Fl. Jowai 1: 191. 1981; Grierson & D.G. Long, Fl. Bhutan 1(3): 601. 1987; Chauhan & al., Fl. Manipur 1: 349. 2000.

Trees or large shrubs, 10-18 m tall, branches sometimes warted, lenticellate, pubescent or white woolly when young. Leaves 3.5 - 15 × 2 - 7.5 cm, oblong to elliptic-oblongate, cuneate at base, acuminate at apex, margin serrate to serrulate, hairy at young age; petiole 7 - 10 mm long. Inflorescence terminal corymbs with few flowers, 4 - 8 cm in diam., deciduous, woolly. Pedicels 6 - 8 mm long. Flowers 6 - 8 mm in diam. Sepals 3 mm long, triangular, glabrous. Petals 4 - 5 mm long, orbicular, white, fragrant, white pubescent at base. Styles 2 - 3, united near base, ovary glabrous. Fruits 7-8 mm in diam., ovoid, yellow when ripe. Seeds 1 - 2 per cell, up to 2 × 3 mm, ellipsoid.

Here the three varieties described by Hook. f. (1878) are keyed below with their typical variety.

### Key to the varieties

- 1a. Branches not lenticellate, leaves usually upto 12.5 × 5.5 cm, margin finely serrulate, persistently woolly beneath; flowers long pedicelled ... 3. *P. arguta* var. *latifolia*
- 1b. Branches warted and lenticellate, leaves upto 15 × 4 cm, margin serrate to distantly serrate, glabrous beneath at age, flowers short pedicelled ... 2
- 2a. Leaf upto 15 × 4 cm, elliptic to oblong lanceolate, margin serrulate, petals pubescent at base ... 1. *P. arguta* var. *arguta*
- 2b. Leaf upto 7.5 × 3 cm, ovate or narrowly lanceolate, margin distantly serrate, petals glabrous at base ... 3
- 3a. Leaves 3.8-6.5 cm long, narrowly lanceolate, apex short acuminate, coriaceous; flowers in contracted corymbs ... 4. *P. arguta* var. *parvifolia*
- 3b. Leaves 5.0-7.5 cm long, ovate-lanceolate, apex caudate acuminate, membranaceous; flowers in lax corymbs at tip of flowering branches ... 2. *P. arguta* var. *membranacea*

### 1. var. *arguta*

*Pourthiaea arguta* (Lindl.) Decne., Nouv. Arch. Mus. Hist. Nat. Paris 10: 147. 1874; Hook. f., Fl. Brit. India 2: 382. 1878; Kanjilal & Das, Fl. Assam, 2: 223. 1938; Deb in Bull. Bot. Surv. India, 3: 259. 1961;

Hara & Ohashi in Fl. E. Himal. 1: 125. 1966. *Sorbus arguta* (Wall. ex Lindl.) Zabel in Bessner, Scheile & Zabel Handb. 200. 1903. *Pourthiaea arguta* (Lindl.) Decne. var. *wallichii* Hook. f., Fl. Brit. India 2: 382. 1878.

*Type*: Bangladesh, Pandua, Sylhet, *Wallich* 672 (K- Holotype; Isotype- CAL, Acc. No. 154247 and 154246!).

*Distribution* : India : Sikkim, NEFA, West Bengal, Meghalaya, Manipur. Bangladesh, Myanmar.

**2. *Photinia arguta* Lindl. var. *membranacea* (Hook. f.) Ghora **comb. nov.****

*Pourthiaea arguta* (Lindl.) Decne. var. *membranacea* Hook. f., Fl. Brit. India 2: 382. 1878.

*Type*: Meghalaya, Khasia, *Griffith* s.n. (K).

*Distribution* : India : Meghalaya.

**3. *Photinia arguta* Lindl. var. *latifolia* (Hook. f.) Ghora **comb. nov.****

*Pourthiaea arguta* (Lindl.) Decne. var. *latifolia* Hook. f., Fl. Brit. India 2: 382. 1878.

*Type*: Myanmar, Hookhoom valley, *Griffith* s.n. (K).

*Distribution* : India : Meghalaya. Myanmar.

**4. *Photinia arguta* Lindl. var. *parvifolia* (Hook. f.) Ghora **comb. nov.****

*Pourthiaea arguta* (Lindl.) Decne. var. *parvifolia* Hook. f., Fl. Brit. India 2: 382. 1878.

*Type*: Meghalaya, Khasia mounts at Jowai, *C.B. Clarke* s.n. (K).

*Distribution* : India: Meghalaya (Khasia at Jowai).

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## RECOLLECTION OF *ARMODORUM SENAPATIANUM* PHUKAN & A.A. MAO (ORCHIDACEAE)

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*Armadorum senapatianum* Phukan & A.A. Mao (in Orch. Rev.110:299. 2002) was described based on a collection from Senapati hills of Manipur. It appears to be rare species as several attempts to collect more plants from the type locality or different places from Manipur was not successful. This species could be of horticultural importance for its beautiful flowers. During November 2009 the author came across a similar plant in flowering condition in garden of a resident in Shillong. On enquiry it was learnt that the plant was collected along with few other orchids from nearby hills of Darjeeling about 6 years back. The plant established itself well on the host tree growing very healthy and is larger than the first collection. The leafy stem is about



Fig. 1. : *Armadorum senapatianum* Phukan & A.A. Mao.: a. habit; b. distichous leaves; c & d. close up flower.

55 cm long with distichous leaves which are c. 25-30 cm long. There are three axillary inflorescence which is about 35 -40 cm long.

A few differences were noted than the type *i.e.* flowers of this plant opening a few at a time in acropetal succession where as in type specimen all flowers opened at the same time. Flowers in this plant are slightly smaller than the type. Most interesting is the flowering time *i.e.* the type specimen flowered in June and lasted for about 10 days and after pollination started wilting whereas this plant started flowering in second week of November a few at a time and continued upto 1st week of January.

To mark this as the second collection after the type of the species for making a voucher specimen the whole plant could not be used since it is a monopodial orchid but the owner was kind enough to give one inflorescence and few leaves for the purpose. The specimen is deposited in herbarium of Botanical Survey of India, Shillong (ASSAM).

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# A NEW VARIETY OF *SCOPARIA DULCIS* L. (SCROPHULARIACEAE ) FROM MUMBAI (MAHARASHTRA), INDIA

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*Scoparia dulcis* var. *abrahamii* Pardeshi & Srinivasu var. *nov.* related to *Scoparia dulcis* L. is described. It differs from the latter in having 4 - 5 faintly pinkish-white, falcate corolla.

***Scoparia dulcis* var. *abrahamii* Pardeshi & Srinivasu var. *nov.***

*S. dulcis* affinis, floribus 0.4 - 0.5 × 0.6 - 0.9 cm; corollis 4 - 5, falcatis, leviter roseo-albidis, differt. (Fig.1).

*Type* : SNP-1002 A (Holotype, Institute of Science, Mumbai) SNP-1002 B (Isotype, BSI).

Perennial under-shrub, stem erect, bushy, densely branched and usually with three branches at each node, glabrous, dull green, ridged, 50 - 90 cm high, stem farinose with fine white dots, 4 - 5 angled below, young branches 4 - 8 angled, ribs prominent, pale green; internode maximum 6.5 cm on main stem and 0.6 cm on branches; leaves exstipulate, short petiolate (0.1 - 0.4 cm), petiole slender, glabrous, leaves simple, deep green above, pale beneath, lamina 0.5 - 2.3 cm long, 0.3 - 1 cm broad, leaves on the main stem larger and 3-nately whorled, rhomboid-obovate, where as those on the branches smaller, both opposite and 3-nately whorled, linear-spathulate, margin singly serrated from the middle of lamina to the apex, lamina broad in centre and tapering at both ends, apex acute, base tapering, glabrous on both surfaces, punctate beneath, foetid, venation reticulate, main nerves 3, alternate, not very prominent. Flower solitary or 2, axillary; complete, actinomorphic, bisexual, hypogynous, tetramerous, white with pinkish tinge, 0.4 - 0.5 × 0.6 - 0.9 cm across on 0.4 - 0.5 cm long pedicel; calyx campanulate, valvate, divided nearly to the base, lobes 4, ovate, 0.2 cm long with 3 parallel nerves, puberulent and ciliolate, persistent; corolla rotate, valvate, fugacious, tube less than 0.1 cm long, pilose with long white hairs (0.2 cm), lobes usually 4, frequently a fifth petal is also present, lobes oblong-sub-acute somewhat falcate (0.3 - 0.4 × 0.15 cm), equal, white with pinkish tinge; stamens 4-5, epipetalous, inserted at the base of corolla tube, filament 0.2 - 0.25 cm, equal, white at the base and pinkish at the apex, anther (1.5 mm. long) pale yellow, versatile, dithecous, oblong-sub-sagittate, extrorse, dehiscence longitudinal; ovary superior, carpels 2, syncarpous, locules 2, ovules many in each locule on axile placentation, style terminal (0.2 cm long), white at the base, pinkish from middle to the apex, stigma capitate; fruit loculicidal capsule, sub globose or sub-ovoid, pale brown, glabrous, 0.2 - 0.3 cm long × 0.3 cm across with persistent style base at the apex, persistent calyx surrounding more than half-way, valves membranous, ultimately 2-fid; seeds many, dark brown, oblong, shortly apiculate at one end with small pitting.

*Fl. & Fr.*: Throughout year.

*Location* : Large population of this variety was located on either side of high ways at Kurla for the first time in July 2003. Later on, it was also found in open sunny places and wastelands at Vikhroli, Andheri, Santacruz, Mahim and New Mumbai.

This new taxon is closely related to *Scoparia dulcis* L. but it differs on following characters.

<i>Scoparia dulcis</i> L. var. <i>abrahamii</i> Pardeshi & Srinivasu	<i>Scoparia dulcis</i> L.
Corolla lobes 4 - 5 (lobes 3.5 - 4 × 1.5 - 2 mm)	Corolla lobes 4 (lobes 2.8 - 3 × 1.5 - 2 mm)
Corolla lobes oblong-subacute, falcate	Corolla lobes oblong-round, not falcate
Corolla white with pinkish tinge (entire lobes)	Corolla white with ring of purplish tinge only at the base of lobes





**Fig. 1.** *Scopia dulcis* var. *abrahamii* Pardeshi & Srinivasu var. *nov.* : A. Habit; B. Leaves; C. Flowering twig; D. Flower with falcate corolla and E. Fruits.

This taxon is named after retired Scientist Dr. V. Abraham, Bhabha Atomic Research Centre, Trombay, Mumbai (India).

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## ON THE IDENTITY OF *ARUNDINARIA CLARKEI* GAMBLE EX BRANDIS (POACEAE : BAMBUSOIDEAE) – ITS RECOLLECTION AND TAXONOMIC POSITION

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The identity of *Arundinaria clarkei* Gamble ex Brandis, a less known bamboo of Eastern India is discussed. It is more appropriately placed under genus *Melocanna*. *Schizostachyum mannii* described by R.B. Majumdar is confirmed as its synonym.

'*Arundinaria clarkei*' as annotated by Gamble was described by Brandis (1906) with meager description. Camus (1913) treated it as a good species under *Arundinaria*, followed by Blatter (1929), Vermah & Bahadur (1980) and Shukla (1996), but without any further addition to our knowledge of this less known bamboo. Majumdar (1989) transferred it to *Neomicrocalamus* Keng as *Arundinaria sensu stricto* is considered a new-world genus. Muktesh Kumar (1998) transferred it to *Racemobambos* Holttum.

Critical study of the type material of *Arundinaria clarkei* deposited in CAL and the fresh collection of vegetative, flowering and fruiting material from Meghalaya revealed that the taxonomic reappraisal of the species is essential.

### Distribution

Brandis (1906) described *Arundinaria clarkei*, citing – "*Arundinaria clarkei*, Gamble MSS. Manipur". However, the single specimen of *Arundinaria clarkei* having a flowering branchlet twig with a hand written note "Type specimen, name published in 'Indian Trees' p. 666 (1906)" and signed by Gamble was collected from 'Cherra end' 2000 ft by C.B. Clarke in October 1867. There is no evidence of other specimens either any Type or other collection from Manipur or any other place for this species. However another species collected by C.B. Clarke 48322 from 'Munneypore' in Nov. 1885 [Herb. Acc. 549483 (CAL)] and annotated by Gamble as "*Bambusa clarkei* new sps." is available having a leafy twig and illustrations of floral parts which is mentioned by Gamble as "material insuff. for description". Present study therefore suggests the strong possibility of misinterpretation of the locality for *Arundinaria clarkei* as Manipur by Brandis (1906).

The type locality of the species given as 'Manipur' instead of 'Cherra end' by Brandis (1906) and followed by subsequent workers appears wrongly placed and it needs to be corrected and known as 'Cherra end (Meghalaya)'.

### Taxonomic history

Describing this species, Brandis (1906) states "A slight shrub 10 ft. high, L. 4-7 by 1/2 - 3/4 inch n. 28-33 on 1/4 inch Stamens 6, hence placed here". Blatter (1929) placing it under doubtful species gave the description as such given by Brandis (1906).

Tiwari (1992) misinterpreted the description given by Blatter (1906) and added the characters "solid" for culm, which was followed by Seethalakshmi & Kumar (1998). Search in all reputed herbaria of the region like ASSAM, CAL, DD, NEHU could not find any further material of this species except C.B. Clarke 5563 (CAL) which could support the description added by the workers after Brandis (1906).

### Taxonomic position

Bor (1940) did not include *Arundinaria clarkei* in his work. Since, *Arundinaria sensu stricto* is a new world genus, Majumdar (1989) transferred it to *Neomicrocalamus* Keng, without any discussion on availability

Table 1 : Comparison of *Arundinaria clarkei* with *Melocanna* and *Racemobambos*.

Characters	Racemobambos	Melocanna	Arundinaria clarkei
Inflorescence	a leafy raceme or small panicle	branched leafy or leafless panicle	spicate panicle on leafy branches
Spikelets	arising in axils of small bract; 2-8 flowered, with terminal rudimentary floret 2-3	clustered in bracts; 1-flowered with or without rachilla extension	clustered in bracts; 1-flowered with terminal hairy rachilla extension
Empty glumes	1 or many	1 or many with immature, abortive buds, convolute, mucronate, glabrous	2 in mature floret, ovate, acute, mucronate, glabrous
Lemma	chartaceous with mucronate or acuminate tip	ovate-lanceolate, convolute, glabrous, sharp mucronate	ovate, acute, glabrous, short-mucronate
Palea	2-keeled	not keeled	very faintly 2-keeled
Lodicules	3	2 - 3	3
Stamens	6, filaments free	6, free or irregularly united	6, exserted, free
Ovary	usually hairy on the upper part	glabrous, continuing into c. 4 mm long hairy style	glabrous, continuing into short style
Stigmas	3, plumose	single or 3, feathery	3, hairy
Fruit	caryopsis	bacca, pyriform, 5-10 cm long, 3-6 cm across, fleshy with long curved beak	bacca, pyriform, 2-3 cm across, 2-4 cm long, with 5-10 mm long, pointed, slightly curved beak

of any fresh evidence. Muktesh Kumar (1998) transferred it to *Racemobambos* Holttum as *Neomicrocalamus* is considered as synonym of the former.

The critical morphological study of vegetative, flowering and fruiting characters, revealed that the species rightly belongs to genus *Melocanna* rather than *Racemobambos* (Table 1). This view is also strengthened by the SEM phylloderm analysis in which the pattern of stomatal arrangement and shape of papillae etc. are similar to that of *Melocanna baccifera*. (Plate 3). A new combination is therefore proposed.

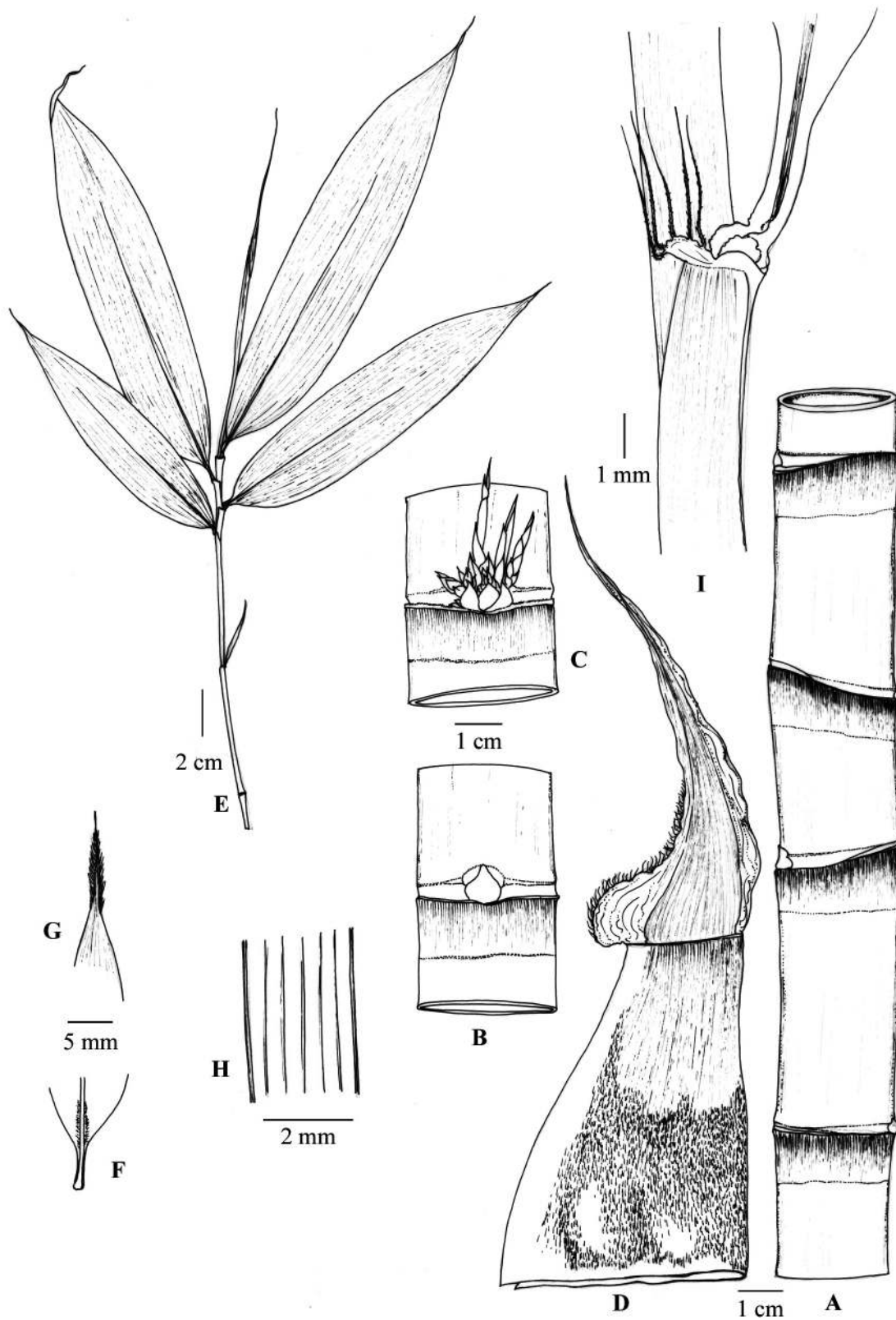
Critical study of the type material of *Arundinaria clarkei* and the fresh collection from Meghalaya (*P. Kumari* 34612, *P. Kumari* 34637; *P. Kumari* & *P. Singh* 34676 & 34683), further revealed that *Schizostachyum mannii* described by R.B. Majumdar is identical with this species. Hence *S. mannii* R.B. Majumdar is relegated to synonymy of *Melocanna clarkei* (Gamble ex Brandis) *P. Kumari* & *P. Singh*.

A detail description along with the illustration and present distribution is given here to facilitate the correct identification of this species.

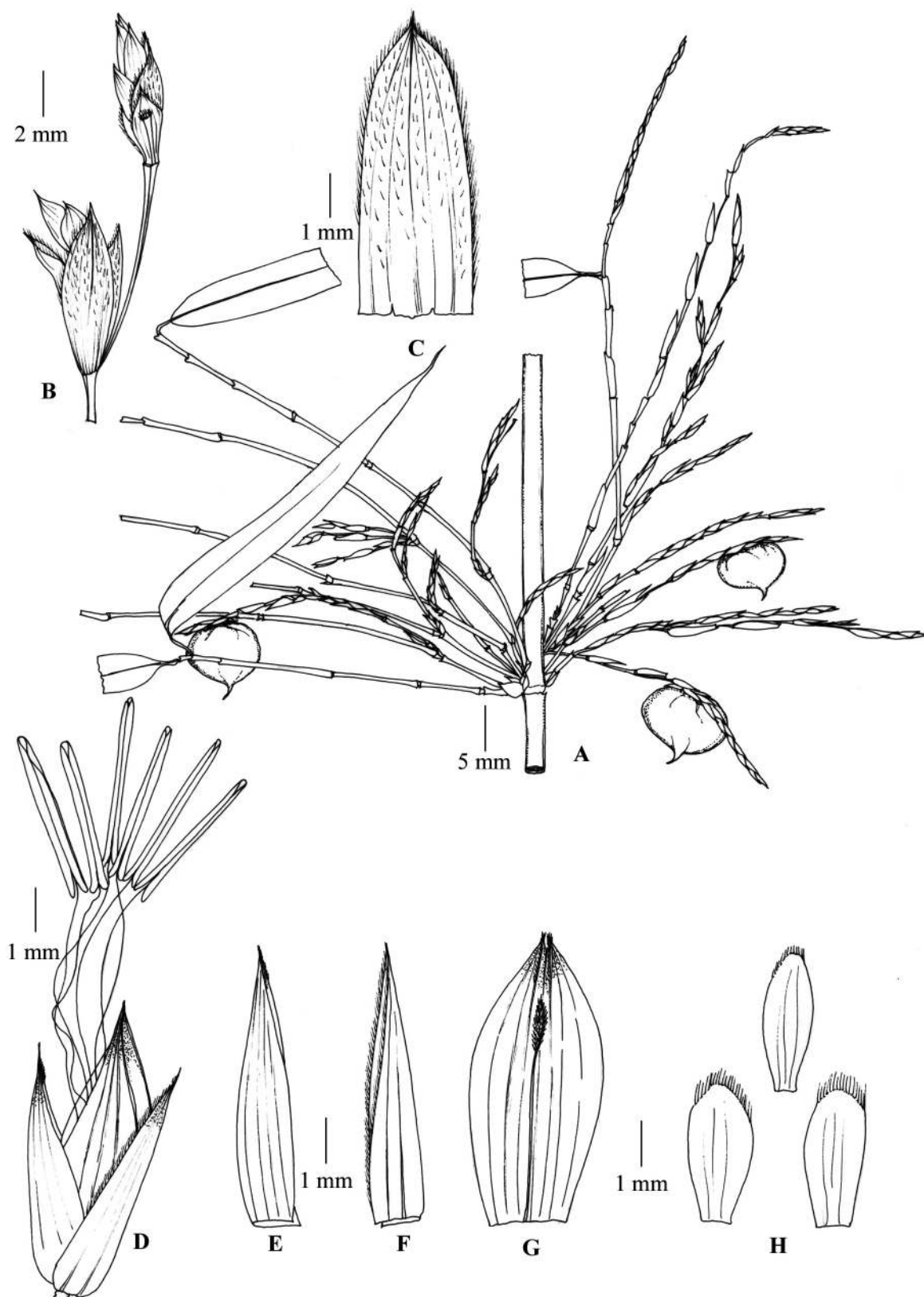
**Melocanna clarkei** (Gamble ex Brandis) *P. Kumari* & *P. Singh* **comb. nov.** *Arundinaria clarkei* Gamble ex Brandis in Ind. Trees 666. 1906; E.G. Camus, Les Bambusees 49. 1913; Blatt. in Ind. For. 55: 547. 1929; Vermah & Bahadur, Ind. For. Rec. 6(1): 1. 1980. *Neomicrocalamus clarkei* (Gamble ex Brandis) R.B. Majumdar in Fl. Ind. Enum. Monocotyl 279. 1989. *Racemobambos clarkei* (Gamble ex Brandis) M. Kumar in Seethalakshmi & Kumar, Bamboos India 230. 1998. *Schizostachyum mannii* R.B. Majumdar in Karthik. & al., Fl. Ind. Enum. Monocotyl 281. 1989; D.N. Tiwari, Monog. Bamboo 144. 1992; U. Shukla, Grass. N.E. India 223. 1996; Seethalakshmi & Kumar, Bamboos India 250. 1998.

*Type* : Cherra end, 2000 ft, Oct. 1867, *C.B. Clarke* 5563 (Holotype, CAL!); 12 km to Umkiang from Jowai, Jaintia hills, 6.9.2005, *P. Kumari* & *P. Singh* 34676 (Epitype CAL! designated here).

Moderate sized, erect bamboo with distant culms. Rhizome pachymorph with 50 - 60 cm or longer solid necks. Culms 10 - 12 m tall, 2 - 3 cm in diameter, light green to yellowish green, turning grayish with age; nodes even, merely a line, oblique, with 1 - 1.5 cm broad white ring below and a thin 2 - 3 mm dark purplish ring above; internodes terete, unequal, much varying in length (5 - 31 cm), hollow, thin walled, wall thickness c. 2 mm; bud short, ovate with ciliate appendages; branch complement with 11 - 12 more or less subequal branches, usually from upper nodes only. Culm-sheaths deciduous, shorter than internodes, triangular, yellowish-brown;



**Fig.1.** *Melocanna clarkei* (Gamble ex Brandis) P. Kumari & P. Singh :  
 A. Culm portion; B. Nodal bud; C. Branches emerging from bud; D. Culm sheath; E. Leafy twig; F. Leafbase;  
 G. Leaf apex; H. Leaf abaxial surface; I. Leaf-sheath. [*P. Kumari* 34637 (CAL)].



**Fig.2.** *Melocanna clarkei* (Gamble ex Brandis) P. Kumari & P. Singh :  
 A. Flowering and Fruiting branches; B. Spiklets; C. Bract;  
 D. Mature floret; E. Empty glume; F. Lemma; G. Palea; H. Lodicules. [*P. Kumari* 34612 (CAL)].





**Plate1.** *Melocanna clarkei* (Gamble ex Brandis) P. Kumari & P. Singh : **A.** Young culms; **B.** Mature culms; **C.** Culm-sheath; **D.** Nodal-bud.





**Plate 2.** *Melocanna clarkei* (Gamble ex Brandis) P. Kumari & P. Singh : **A.** Flowering; **B.** Inflorescence, Inset stamen; **C.** Fruits; **D.** Seedlings.

sheath proper 8 - 10 cm long, 10 - 12 cm broad at base, gradually attaining into 4 - 5 cm broad, truncate top, thin, crustaceous, rolled, faintly striate, densely appressed blackish-brown hairs on outer surface below, glabrous smooth on inner surface, margins smooth; imperfect blade as long as sheath proper, caducous, erect, striate, with inflated, broad, rounded base and acuminate, recurved apex, long ciliate (deciduous) at incurved margins; ligule c. 1 mm high, entire, smooth; auricles obscure. Leaves 5 - 6 per twig; leaf-blades lanceolate, 18 - 25 cm long, 2 - 3 cm broad, unequally, rounded-attenuate at base terminating somewhat acuminate into 1 - 1.5 cm long feathery apex with setaceous tip, glabrous on both surfaces except 1 - 2 scabrid nerves along one margin on adaxial surface and few hairs near base on abaxial surface, smooth at margins; mid vein thin, prominent, glabrous, secondary veins 8 - 10, tertiary veins 5 - 7, faint, not easily distinguished, few faint hair like dots are observed on abaxial surface; pseudopetiole 6-7 mm, swollen, bulging; leaf-sheath faintly striate, somewhat thin keeled, glabrous, ending into rounded, narrow callus, ciliate at margins first afterwards smooth; ligule narrow, truncate, glabrous, except few hairs near petiole attachment; auricles roundedly-elongate, somewhat pointed, bearing 5 - 6, c. 5 mm long cilia. Inflorescence spicate panicle on leafy branches; branches 15 - 30 cm long, 10 - 12 drooping at culm nodes; each branch nodes bearing 2 - 3, 10 - 15 cm long branchlets; rachis striated, hirsute, somewhat flattened at one side, bearing clusters of spikelets in bracts. Spikelets bracteate, having lower 2 - 4 prophylls and glumes with immature floret buds and terminal mature flower with hairy rachilla extension; bracts c. 1.2 cm long, ovate-lanceolate, mucronate, pubescent on outer surface, long ciliate along margins; rachilla 1 - 2 mm long, flattened at one side, glabrous except very few minute cilia at apex; empty glumes 2 in mature floret, 5 - 6 mm long, ovate, acute, mucronate, 5 - 7 nerved, glabrous, ciliate along margins; lemma c. 6 mm long, ovate, acute, short mucronate, 9-nerved, glabrous, minutely ciliate at apex on margins; palea equal or slightly longer than lemma, ovate, acute, faintly 2-keeled, 1-nerved between keels, 2-nerved on either side, glabrous entirely except few minute hairs at apex, with terminal rachilla extension hairy at apex; stamens 6, c. 4 mm long, exserted, blunt at purplish apex; ovary c. 0.5 mm, glabrous, continuing into short style, which soon divides into 3, hairy stigmas; lodicules 3, c. 3 mm, oblong, ovate, white fimbriate at top, hyaline, transparent, becoming somewhat fleshy afterwards; fruits fleshy, pyriform, 2 - 3 cm across, 2 - 4 cm long, with 5 - 10 mm long, pointed, slightly curved beak. (**Fig. 1 & 2; Plate 1 & 2**).

### SEM features

Stomata – common, low dome, overarched from both ends by two elongate papillae giving ‘X’ shaped appearance; prickles frequent along mid vein; microhairs – infrequent; macrohairs – very rare, along mid vein, base swollen. (**Plate 3**).

*Fl.* : May - April.

*New shoot*: August - September.

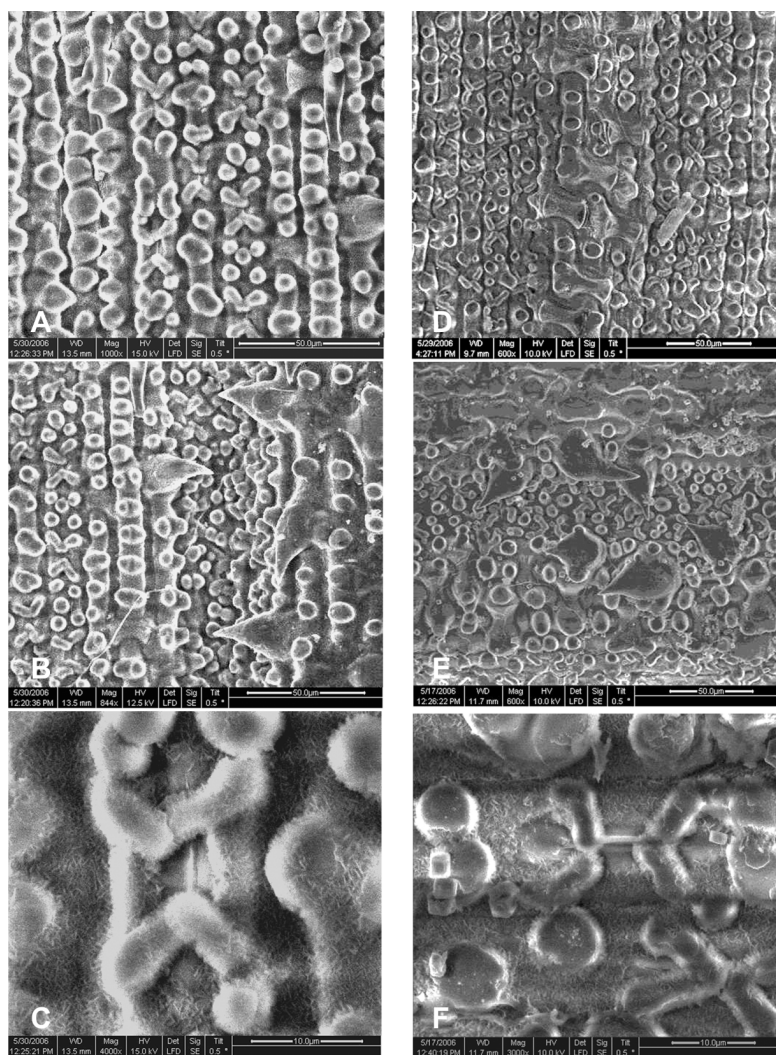
*Distribution* : India : Meghalaya (Khasi hills – Laityrra, Cherrapunjee-Sellah; Jaintia hills - Jowai, below Sundai, Umtulu river site, Lashka dam site, near Umkiang), Manipur, Mizoram, Nagaland. (Technical report, 2001 by SFRI, Itanagar).

*Habitat* : Found between 900-1600 m in sub-tropical to warm temperate zone. Grows in hilly evergreen forests forming large, spreading patches.

*Specimens examined* : India : Meghalaya: Cherra end, 2000 ft, Oct. 1867, *C.B. Clarke* 5563 (holo, CAL); Jaintia hills, Jowai, 915 m, Aug. 1889, *G. Mann* 4846 (DD); Jaintia hills, 1220 m, April 1889, *G. Mann* s.n. (DD); Jaintia hills, below Sundai, March 1890, *G. Mann* s.n. (CAL); Umtulu river in Jaintia hills, about 15 miles from Jowai, April 1889, *G. Mann* s.n. (CAL); Khasi hills, Laityrra, 760 m, 22.4.1985, *H.B. Naithani* Sr. II 1287 (DD); Jaintia hills, 12 km to Umkiang from Jowai, 9.4.2004, *P. Kumari* 34612 (CAL); Khasi hills, Laityrra, 28.4.2004, *P. Kumari* 34637 (CAL); Jaintia hills, 12 km to Umkiang from Jowai, 6.9.2005, *P. Kumari & P. Singh* 34676 (CAL); Jaintia hills, Lashka dam site, 7.9.2005, *P. Kumari & P. Singh* 34683 (CAL).

### ACKNOWLEDGEMENTS

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**Plate 3.** Comparision of *Melocanna baccifera* & *M. clarkei*  
SEM leaf-abaxial surface structures: **A - C.** *M. baccifera* (Roxb.) Kurz  
[*P. Kumari* 25161 (CAL)]. **D - F.** *M. clarkei* (Gamble ex Brandis) P. Kumari &  
P. Singh [*P. Kumari* 34612 (CAL)].

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**NOTES ON FLOWERING IN *SCHIZOSTACHYUM*  
*ARUNACHALENSIS* H.B. NAITHANI (POACEAE: BAMBUSOIDEAE)**

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During present study *Schizostachyum arunachalensis* was found flowering and fruiting in the wild on the hill slopes in Kane Wildlife Sanctuary of West Siang district (Arunachal Pradesh). A good population was observed near Magee village which is about 10 km from Elephant Camp. This bamboo can be easily distinguished by long internodes, larger leaves and peculiar leaf sheaths. A supplemented taxonomic description of this bamboo is provided. In light of flowering and fruiting material available now, its taxonomic placement in the new genus *Stapletonia* has been suggested, a new combination has been proposed, and coloured photographs have been provided to facilitate identification.

**STAPLETONIA** P.Singh, S.S.Dash & P.Kumari **gen. nov.**

*Typus species: Stapletonia arunachalensis* (H.B. Naithani) P. Singh, S.S. Dash & P. Kumari. *Schizostachyum arunachalensis* H.B.Naithani.

affinis *Cephalostachyum* sed auriculis folio vaginae ad 1 cm longae fringitis, baccis succulentis, c.5 cm longis differt.

Shrubby bamboo, forming loose clumps or diffused. Rhizome pachymorph with extended necks. Culms erect at base, clambering above, walls thin. Nodal branches subequal. Leaf-blade unequal at base; leaf-sheath auricles prominent with c. 1 cm long fringes. Inflorescence iterant, bracteate, in large densely glomerate heads. Spikelets 1-flowered with terminal rhachilla extension. Glumes 6-8, long aristate. Lemma shortly aristate, rosy pink. Palea narrowly 2-keeled. Lodicules 3, large. Stamens 6, filaments free. Ovary stalked, glabrous; style long; stigma 2, hairy. Fruit apple shaped, fleshy, with persistent style base.

*Etymology* : This genus is named in honor of Dr. C.M.A. Stapleton who made significant contributions to the taxonomy of Himalayan bamboos.

*Notes* : The genus *Stapletonia* shows some affinities with *Cephalostachyum* in habit and habitat but differs mainly in having fringed leaf auricles, 6-8 glumes and fleshy fruits about 5 cm across. A comparison of morphological characters of all the related genera are given in a tabular form (Table-1).

**Stapletonia arunachalensis** (H.B.Naithani) P.Singh, S.S.Dash & P.Kumari **comb. nov.**

*Schizostachyum arunachalensis* H.B. Naithani, Ind. For. 118 (3): 230. 1992. (Baja near Daporijo, 300 m, Subansiri District, Arunachal Pradesh, 17.3.1986, H.B. Naithani 1406 (holotype, DD).

*Vern.*: “Tuchur” (Adi and Miri); “Tauk” (Gallongs); “To” (Apatanis); “Tabom” (Nishis).

A semiscandent bamboo. Rhizome pachymorph. Culms 10-15 m high, 6-7 cm in diameter, at first erect then branches pendulous, dark green when young turning yellow with age; nodes swollen, with a ring of fallen culm-sheath base and c. 1 cm broad ring of thick, brown deciduous hairs; internodes terete, at base c. 20 cm long and up to 1.5 m or more long above, smooth, hollow, walls 5-10 mm thick; bud oval, rounded at apex; branches 6 (4, 2 cm in girth). Culm-sheaths deciduous, shorter than internodes, brownish, thick crustaceous; sheath proper covered with yellow-brown hairs on outer surface, glabrous inside, 15-26 cm long, 12-14 cm broad at base, sides more or less parallel with 10-11 cm broad obliquely round top; one margin completely

Table 1 : A comparison of *Stapletonia* with allied genera.

Characters	Melocanna	Cephalostachyum	Schizostachyum	Pseudostachyum	Teinostachyum	Melocalamus	Stapletonia
Habit	Arborescent	Arborescent or shrubby	Arborescent sometimes shrubby or scrambling	Shrubby	Arborescent	Climbing bamboos	Shrubby bamboos
Rhizome	Pachymorph, long necked	Pachymorph, short necked	Pachymorph, short necked	Pachymorph, long necked	Pachymorph, without extended necks	Pachymorph, short necked	Pachymorph with extended necks
Culm	Erect, thin walled	Erect, pendulous or clambering, thin wall	Erect or scrambling, usually thin walled	Erect with pendulous tips, thin walled	Erect or pendulous, usually thin walled	Clambering, nearly solid	Erect at base, clambering above, walls thin
Culm sheath	Persistent, crustaceous, blade erect, auricles absent	Deciduous, thickly papery to leathery, blade reflexed, auricles conspicuous, oral setae prominent	Deciduous, leathery to thick papery, auricles inconspicuous	Deciduous, blade deciduous, erect, auricles very small	Ridged, edges thick, blade rolled longer than sheath, oral setae prominent	Leathery, auricles present or absent	Deciduous, thick crustaceous, blade triangular shorter than sheath, auricle obscure, with transverse veins, one side longer
Mid-culm branches	Many, subequal	Many, subequal,	Many, subequal	Many, clustered, subequal	Subequal, sometimes dominating branch replacing the main culm	Many, one dominant	Many, subequal
Leaves	Leaf sheath auricles absent; leaf blade lanceolate	Leaf sheath auricles present or absent; leaf blades liner, lanceolate, oblong or ovate	Leaf sheath auricles present or absent; leaf blades liner, lanceolate, oblong or ovate	Leaf blades, lanceolate or oblong	Leaf blades, lanceolate or oblong	Leaf sheath auricles present or absent; leaf blades lanceolate or oblong	Leaf sheath auricles prominent, fringed hairy; Leaf blade oblong lanceolate obliquely attenuate at base
Inflorescence	Iterauctant, fully bracteate	Iterauctant, fully bracteate, globular or subglobular heads	Iterauctant, fully bracteate	Iterauctant, fully bracteate panicles	Iterauctant, fully bracteate, spicate	Iterauctant, arranged glomerately on large leaf less flowering branch	Iterauctant, bracteate, in large densely glomerate heads
Spikelets	1-fertile floret and 1-several sterile, rhachilla articulate	1-flowered with rhachilla extension	1-2, or florets 3-4 with only terminal or subterminal fertile, rhachilla extending beyond fertile floret	Solitary or several clustered in the axils of the bracts, with one fertile floret	Several fertile florets, with rudimentary floret or rhachilla extension	2- flowered with rhachilla extension	1-flowered with rhachilla extension
Glumes	2-4	2-3	Usually absent	1	Several	2	6-8
Lemma	Similar to glumes	Similar to glumes	Convolute	Similar to glume	Similar to glume	Similar to glume	Similar to glumes
Palea	Convolute	2-keeled	Not keeled	2-keeled	2-keeled	2-keeled	Narrowly 2-keeled
Lodicules	2	3	Usually absent, sometimes 1-3	3-5, persistent	2-3	3	3, persistent
Stamens	6, filaments free or irregularly connate	6, filaments free	6, filaments usually free	6, filaments free	6, filaments free or connate	6, filaments free	6, filaments free
Pistil	Glabrous, Style long, Stigma 2-4, hairy	Stalked, Style long, Stigma 2-3 plumose	Stalked, Style Simple, Stigma 3, plumose	Stalked, glabrous, Style long, Stigma 2	Style long	Stalk less, Style short	Stalked, glabrous, Style long, Stigma 2, hairy
Fruit	Pear shaped, large, beaked at apex, pericarp thick, fleshy	Nut like, terete, apex with persistent style	Caryopsis fusiform, with persistent style base	Globose, base with persistent glumes, lemma, palea and lodicules, beaked at apex, pericarp crustaceous	Rostrate	Berry like, globose, with fleshy pericarp	Apple shaped, fleshy, with persistent glumes, lemma, palea and lodicules, beaked at apex, pericarp fleshy



**Fig. 1:** *Stapletonia arunachalensis* (H.B. Naithani) P. Singh, S.S. Dash & P. Kumari  
**A.** Habit; **B.** Culm sheath; **C.** Sterile flowering head; **D.** Flowering head with  
fertile spikelets and drooping anthers; **E.** Sterile and fertile spikelets; **F.** Fertile spikelet;  
**G.** Fructescence; **H.** A fruit with persistent style; **J.** Cross section of fruit;  
**K.** Germinating fruit; **L.** Young seedling showing rhizome with extended necks.

ciliate, another usually at top only, cilia c. 2 mm long, dense, dark brown; imperfect blade shorter than sheath proper, 10-25 cm long, 9-11 cm broad, triangular, one side longer than the other, rounded at base, acute at apex, erect, transversely veined, minute hirsute at somewhat wrinkled base on outer surface, scanty appressed hairy on inner surface, margins ciliate at base, smooth upwards; ligule narrow, entire. Leaf-blades oblong-lanceolate, up to 48 cm long and 18 cm broad, obliquely attenuate at base, acuminate at apex with c. 2 cm long, incurved, twisted setaceous apex, minutely hirsute on abaxial surface; midrib raised, prominent, glabrous, secondary veins 12-18 pairs, tertiary 5-7(8), pseudopetiole 1- 1.5 cm long; leaf-sheaths striate, thin keeled, puberulous, ending above in a thin callus, densely ciliate at margins; ligule narrow; auricles oblong-conical, extending along margins up to c. 1.5 cm length, long fringed, fringes c. 1 cm long, deciduous. Inflorescence a dense, globular, terminal or subterminal head, 6-10 cm in diameter consisting of fertile spikelets among majority of empty aristate bracts or sterile spikelets. Fertile spikelets c. 4 cm long, glabrous; empty glumes 6-8, 1.2 - 3 cm long, ovate at base, long scabrous-aristate above, glabrous, striate, 5-7 nerved. Lemma 2.5 - 3.5 cm long, shortly aristate, rosy pink. Palea 2-3 cm long, rosy pink, narrowly 2-keeled. Rhachilla extension c. 0.5 cm long, hairy in lower half. Lodicules 3, c. 1.3 cm. long, lanceolate, papillate hairy on inner surface, glabrous outside, ciliate on margins, rosy pink, white near base. Stamens c. 5 cm long; anthers c. 1 cm long; filaments free, thread like. Pistil stipitate, c. 3 cm long; style long, hollow; stigma bifid, hairy. Fruit c. 5 cm across, globose, slightly depressed at top with elongated persistent, acicular style when young (**Fig. 1**).

*Specimens examined* : Arunachal Pradesh : Upper Subansiri district, Daporijo, 11.4.2005, *Tika Prasad Sharma* 34537 veg.(CAL). West Siang district, Kane Wildlife Sanctuary, 27° 39' 41" N, 94° 42' 14" E, 13-09-2009, *S.S. Dash* 32210 & 32211 (ARUN, CAL). Kane wildlife sanctuary, 27° 39' 41" N, 94° 42' 14" E, 20-12-2009, *S S Dash* 32800 (ARUN).

*Distribution and Ecology* : The species is endemic to Arunachal Pradesh, distributed in East Siang, West Siang and Upper Subansiri districts. It is found growing at an altitude of 300-900 m above msl in the tropical evergreen forests and also as pure patches along the shallow streams. The gregarious flowering has been observed for the first time.

*Conservation status* : This bamboo with the longest internodes amongst the Indian species is extracted for use in making baskets and other handicraft items. The recent study by the authors revealed that the species needs appropriate conservation and management strategies for sustainable utilization.

*Note* : Naithani (op. cit.) described this species based on vegetative material and assigned it to the genus *Schizostachyum*. Inflorescence in globular heads shows resemblance to *Cephalostachyum* but succulent baccate fruit found during present studies compelled us to place it in a new genus.

Amongst the Indian bamboos, this species is with the longest internodes and the largest leaves. It also has very characteristic leaf sheath auricles having c. 1 cm long fringes. Inflorescence is in large dense globular heads and fruits are apple shaped, fleshy.

#### ACKNOWLEDGEMENTS

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# WESTERN HIMALAYA — A NEW RANGE OF DISTRIBUTION FOR A CRITICALLY ENDANGERED FERN, *DRYOPSIS MANIPURENSIS* (BEDD.) HOLTUM & P.J.EDWARDS

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During survey tours of Gini area at the base of Kalamuni mountain range, Munshiyari, Pithoragarh, Uttarakhand, in 1998 and 2005, the authors came across an unrecognised fern. But due to its unusual frond-morphology, resembling on the one hand certain members of Thelypteridaceae (vis. *Thelypteris ornata* (Wall. ex Bedd.) Ching and *Thelypteris torresiana* (Gaudich.) Alston, in Sect. Macrothelypteris) and on the other some Dryopteroid ferns, it remained unidentified for more than 10 years. Recently Fraser-Jenkins (2008) published two photographs of *Dryopsis manipurensis* (Bedd.) Holttum & P.J. Edwards, which exactly match our specimen. On sending images to Fraser-Jenkins with further information and discussion at Gangtok during his recent visit (September-October 2009), he confirmed its identity as *Dryopsis manipurensis*.

This species was first described by Beddome (1888) as *Polypodium manipurensis* based on a collection of Sir George Watt, from Sirohifuror, 6000-7000 ft., Manipur, and in his subsequent publication (1892) he transferred it to the genus *Phegopteris*. Another two localities cited by Beddome are Mairang, Khasi Hills (a collection of Gustav Mann), and Nepal (Wallich, Num. List. 322. Sheet no. 2). However Fraser-Jenkins (pers. comm.) points out that Clarke (1880: 527) correctly identified Wallich's Cat. 322 sheet 2 as the very closely related S. Indian species, now known as *Dryopsis scabrosa* (Kunze) Holttum & P.J. Edwards. The specimen (in K-W, seen by CRFJ) has markedly longer basal basiscopic pinnae, more spaced segments and a less densely scaly stipe than *D. manipurensis* and belongs to *D. scabrosa*. Clarke clearly stated that he doubted the locality in Wallich's mixed numbers, which included Wight's S. Indian specimens sorted into his numbers by eye according to general likeness. *D. manipurensis* has never been known from Nepal, despite sometimes being so listed in error due to the muddled locality of Wallich's specimen.

*D. manipurensis* is one of the rarer pteridophytes of India. Chandra and Fraser-Jenkins (2008) listed it at risk of extinction and mentioned it under the Critically Endangered (CE) category of IUCN. Hence the occurrence of this rare, endangered and threatened (RET) plant in the Western Himalaya is important from the point of view of conservation and phytogeography. A brief note is given here concerning its distribution and taxonomy.

Out of 25 species of the S.E. Asian genus *Dryopsis* Holttum & P.J. Edwards, only 6 species occur in India (Fraser-Jenkins & Benniamin, in prep. and Baishya & Fraser-Jenkins, in prep., will report two more from Arunachal Pradesh), of which 4 are distributed in the Indo-Himalaya and further east, and two, *D. scabrosa* (Kunze) Holttum & P.J. Edwards and *D. ferruginea* (Baker) Holttum & P.J. Edwards, are endemic to South India (Fraser-Jenkins 2008). The Indo-Himalayan species were earlier thought to occur only from Nepal eastwards, but recently another, bipinnatifid species, *D. apiciflora* (Wall. ex Mett.) Holttum & P.J. Edwards has been found in Kumaon (Fraser-Jenkins, pers. comm. June 2010).

The differences between *D. manipurensis* (from North India) and *D. scabrosa* (from South India) have been clearly mentioned in the literature (Beddome 1892, Baker 1892). Before the establishment of *D. manipurensis*, Hooker and Baker (1868) while describing *D. scabrosa* (under *Nephrodium* (*Lastrea*) *scabrosum* Baker, from Neilgherries) also mentioned the distinctness between north and south Indian plants and said "We have a closely allied plant from Sikkim and Moulmein with tufted fronds, larger and more delicate in texture, which will probably prove distinct." but they did not cite any sheet from Sikkim or Moulmein (S.E. Myanmar) and to date there are no reports or specimens indicating the occurrence of *D. manipurensis*





**Fig. 1.** A. *Dryopsis manipurensis*; B. Basal pinnae; C. Undersurface of lamina showing sori.

or *D. scabrosa* from Sikkim or Myanmar. However, in recent Indian literature, these species are poorly understood and often confused with each other; hence their distribution was mistakenly confused by Chandra (2000) who listed both *D. manipurensis* and *D. scabrosa* from the Himalaya. Though Dixit (1984) omitted *D. manipurensis* and reported only *D. scabrosa* (under *Ctenitis*) from South India, Dixit & Ghosh (1987) detailed and illustrated it from their collection from Manipur.

The confusion was created among Indian Pteridologists probably after Clarke (1880) cited the specimen of Wallich Cat. 322. sheet no.2 as *Nephrodium scabrosum* Baker (= *Dryopsis scabrosa*) with the note “but is ticketed from Nepal”. On the other hand, while describing new species Beddome identified this sheet as *Polypodium manipurense* instead of *N. scabrosa* (Beddome 1888, 1892) and his mistake was also followed by Holttum and Edwards (1986) as they cited the same specimens under *Dryopsis manipurensis* during



establishment of genus *Dryopsis* by redefining and upgrading one of the subgenera of the genus *Ctenitis* (Ching 1938). But recently Fraser Jenkins (2008) agreed with Clarke (1880) about the mislabelling of sheet no 2. of Wall. Cat. 322 and has reidentified the specimen as belonging to *D. scabrosa* from South India. Despite the efforts of Indian Liaison officer at Kew the specimen from Nepal was not found by him, however, he was able to send good quality digital images of type-sheets of *D. manipurensis* and of *D. scabrosa*.

The range of distribution of *D. manipurensis* is India, the Philippines and Papua, New Guinea (Holttum and Edwards 1986). In the Indian region it is present in Uttarakhand (Gini, Pithoragarh, present collection); Arunachal Pradesh (Baishya & Fraser-Jenkins, in prep.); Meghalaya, Mairang in the Khasi hills (G. Mann) and recently recollected by Fraser-Jenkins) and Manipur (G. Watt; Dixit).

**Dryopsis manipurensis** (Bedd.) Holttum & P.J. Edwards, Kew Bull. 41(1): 200. 1985; Fraser-Jenkins, Tax. Rev. Three Hundred Indian Subcont. Pterid. 195 & 625. fig. 235-236. 2008. *Polypodium manipurens* Bedd., J. Bot. London. 235. 1888. *Phegopteris manipurensis* (Bedd.) Bedd., Suppl. Handb. Ferns Brit. India, 83. 1892. *Dryopteris manipurensis* (Bedd.) C. Chr., Ind. Fil. 1: 276. 1906. *Polypodium* (Subgen. *Phegopteris*) *manipurens* (Bedd.) Baker, Ann. Bot. 5: 76. 1891. *Ctenitis manipurensis* (Bedd.) Ching, Bull. Fan Mem. Inst. Biol. 8: 297. 1938; Dixit & Ghosh, Bull. Bot. Surv. India 27: 118. 1987. *Dryopteris copelandii* Christ, Philipp. J. Sci. 2C: 216. 1907. *Ctenitis copelandii* (Christ) Copel., Gen. Fil. 124. 1947.

Rhizome thick, short, erect, stipe 15-25 cm long, densely scaly, scales, ferrugineous-brown, translucent, broadly or ovate-lanceolate, pale brown, apex acuminate, narrow scales are also intermixed with broad scales; Lamina 30 - 40 × 12 - 20 cm, ovate-deltate, bipinnate and again pinnatifid, or becoming tripinnate at the base, herbaceous, setose and with hair like narrow scales; rachis densely covered by few broad scales and many narrow, hair-like scales; pinnae 20 pairs or more, basal pair largest and long stalked, up to 15 cm or more long, pinnules many pairs, basal pair largest though not abruptly so, 5-7 cm long, segments deeply lobed, roundish, dentate; veins forked; sori globose, medial, generally single in a lobe, medial, indusium not seen, but absent or vestigial (**Fig. 1**).

*Specimens examined* : Uttarakhand, Pithoragarh, Gini, 2100 -2200m before 1.5 Km to Gini from Girigaon, c. 1 km below the road B.S. Kholia 98-083, date Nov. 1998; B.S. Kholia & K. Bhakuni 2005-74, 2005-75, Sept. 2005 about 2 km after Gini to Ratapani c. 1 km above the road (collections deposited in Department of Botany, Govt. P. G. College, Pithoragarh) Digital images examined: Manipur, George Watt 6423 (Holotype, K); Mairang, Khasi Hills, G. Mann (K).

Digital images of *D. scabrosa* also examined: Acc. H 2005/00425 -13 K, Neotype, Ed. R. F. Hohenacker 124; Acc. H 2005/00425 -15 K, Beddome and Acc. H 2005/00425 -14 K.

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## VALIDATION OF THE SECTION *MABA* OF *DIOSPYROS* L. (EBENACEAE)

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Singh (2005) in monographic studies on Indian *Diospyros* L., supports Bakhuizen (1936 – 1941) and White (1980) in treating the genus *Maba* J. R. & G. Forst. (1775) as congeneric with *Diospyros* (1753). However, Singh differs by relegating *Maba* to sectional rank rather than considering it as subgenus and made a new combination without citing the basionym. The combination *Diospyros* L. sect. *Maba* (J. R. & G. Forst.) V. Singh is invalid, as Art. 33.4 of the Vienna code (ICBN, 2006) states that the basionym has to be indicated when a new combination is made on or after 1st January 1953. Therefore, the sectional name is validated here accordingly.

***Diospyros* L. sect. *Maba* (J. R. & G. Forst.) V. Singh & V. S. Kumar **comb. et stat. nov.** *Maba* J. R. & G. Forst., Char. Gen. Pl. 121. 1775. *Diospyros* L. subgen. *Maba* (J. R. & G. Forst.) Bakh., Bull. Jard. Bot. Buitenzorg Ser. 3, 15: 7, 50. 1937. (Type species: *Maba elliptica* J. R. & G. Forst. *l.c.* 122, t. 61. = ***Diospyros elliptica* (J. R. & G. Forst.) P. S. Green, Kew Bull. 23: 340. 1969).****

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## CONTRIBUTION TO *LITSEA* LAM. (LAURACEAE) IN NORTHEAST INDIA

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Distribution of 10 species of *Litsea* Lam. in different states of northeast India has been reassessed in the present paper. Correct nomenclature, citation, distribution, specimens examined and notes have been provided for each species. Of these 7 species from Arunachal Pradesh, 3 from Meghalaya, 1 from Manipur, 2 from Mizoram and 3 from Nagaland are recorded for the first time.

1. ***Litsea assamica*** (Meisn.) Hook. f., Fl. Brit. India. 5: 161. 1886; Kanjilal & al., Fl. Assam 4: 85. 1940. *Tetranthera rangoonensis* Meisn. var. *assamica* Meisn. in DC. Prodr. 15 (1): 188. 1864.

*Habitat* : Evergreen forests, in low hills of northeastern India.

*Distribution* : India: Arunachal Pradesh, Assam, Meghalaya. Endemic.

*Specimens examined* : Arunachal Pradesh, Tirap district, Banfera FD, 3-9-1958, *G. Panigrahi* 16705, frts (CAL); Banfera, 13-7-1961, *D.B. Deb* 26705, frts (ASSAM, CAL); Meghalaya, Khasi & Jyntea Hills, 5-2-1915, *U. Kanjilal* 116P, male fls (ASSAM).

*Notes* : The species was recorded from Assam plains (Hooker 1886; Kanjilal & al., 1940) based on two collections of Jenkins and Griffith. It was collected from Arunachal Pradesh and Meghalaya by Deb and Kanjilal but wrongly identified as *Litsea oblonga* Wall. It has been for the first time recorded from these two states.

2. ***Litsea chartacea*** (Wall ex Nees) Hook. f., Fl. Brit. India. 5: 170. 1886; Allen in Ann. Missouri Bot. Gar. 25: 377. 1938; Hara, Enum. Fl. Pl. Nepal 3: 185. 1982. D.G. Long in Grierson & D.G. Long, Fl. Bhutan 1(2): 275. 1984. *Tetranthera chartacea* Wall. ex Nees in Wall., Pl. As. Rar. 2: 67. 1831 & 3: 30. 1831.

*Fl.*: December to March; *Fr.*: February to June.

*Habitat* : Warm broad-leaved evergreen forests, from 1500 m to 1800 m.

*Distribution* : India: Arunachal Pradesh, Assam, Meghalaya, Mizoram, Sikkim, West Bengal. Bhutan, China, Nepal.

*Specimens examined* : Arunachal Pradesh, Lower Dibang Valley district, Mishmi hill, Parasuram Road, 3-2-1939, *R. N. De* 19176, buds (ASSAM); Lower Subansiri district, Pange, 2-11-1980, *G. D. Pal* 78408, buds (ARUN); Chessa, 8-5-1984, *K. Haridasan* 0375, frts (APFH); Tirap district, 13-6-1983, *K. Haridasan* 0663, frts (APFH); West Kameng district, Tippi, Deomali, Hollong forest, 12-6-1983, *K. Haridasan* 0670, frts (APFH); Assam, Sibsagar district, Chamugun, 280 ft, 15-12-1913, *U. Kanjilal* 122M, male buds (ASSAM); Meghalaya, East Khasi Hills district, Mawsmat forest, 11-11-1938, *R. N. De* 18100, buds (ASSAM); Mawsmat forest, 11-11-1938, *S. R. Sharma* 18264, male buds (ASSAM); Ri-Bhoi district, Nongpoh, 2100 ft, 01-06-1914, *U. Kanjilal* 3999, frts (CAL); West Garo Hills district, Tura Top, 366.6 m-1294.6 m, 12-12-1960, *G. Panigrahi* 22374, male fls (ASSAM); Mizoram, Mizo hills, *D. B. Deb* 30909, male fls (ASSAM).

*Notes* : Earlier the species was reported from Sikkim and West Bengal (Hooker, 1886; Long & Grierson, 1984) in eastern Himalayas but present study reveals that it is also a component of the Flora of Arunachal Pradesh, Meghalaya and Mizo hills. Most of specimens in herbaria are wrongly identified as *L. laeta* (Wall. ex Nees) Hook. f. which has more coriaceous leaves and longer umbel peduncles.

3. ***Litsea doshia*** (Buch - Ham. ex D. Don) Kosterm. in J. Sci. Res. Indonesia 1: 90. 1952. *Tetranthera doshia* Buch - Ham. ex D. Don, Prodr. Fl. Nepal. 65. 1825. *Litsea oblonga* (Wall. ex Nees) Hook. f. Fl. Brit. India. 5: 168. 1886; Kosterm. Bibl. Laur. 856. 1964; Momiyama in Fl. E. Him. 3: 42. 1975; Kanjilal & al., Fl. Assam 4: 88. 1940.

*Fl.*: September to January; *Fr.*: December to April.

*Habitat* : Evergreen and mixed forests at an altitude of 1300 – 2700 m.

*Distribution* : India : Arunachal Pradesh, Assam, Meghalaya. Myanmar, Nepal.

*Specimens examined* : Arunachal Pradesh, Lower Subansiri district, Hapoli-Pange Road, 31-10-1980, *G. D. Pal* 78381, buds (ARUN).

*Notes* : The species was reported from Assam and Meghalaya (Kanjilal & al., 1940). It is mostly confused with *L. salicifolia* (Roxb. ex Nees) Hook. f. which has umbels arising in clusters and not in racemes. It is reported from Arunachal Pradesh for the first time.

4. ***Litsea kingii*** Hook. f., Fl. Brit. India. 5: 156. 1886; Kanjilal & al., Fl. Assam 4: 81. 1940; Hara, Fl. E. Himal. 1:102. 1966; 2: 39. 1971; D.G. Long in Grierson & D.G. Long, Fl. Bhutan 1(2): 274. 1984.

*Fl.* : March to July; *Fr.*: May to December.

*Habitat* : Cool broad-leaved and Rhododendron forests at an altitude of 1800 - 2900 m.

*Distribution* : India : Arunachal Pradesh, Meghalaya, Sikkim, West Bengal. Bhutan, Myanmar, China, Nepal.

*Specimens examined* : Arunachal Pradesh, Changlang district, Namdapha, Gandhigram, January 1994, *A. S. Chauhan* 99635, male buds (ASSAM); Kameng district, 4.5-5 miles from Dynmadong, 20-5-1965, *R.S.Rao* 7634, frts. (CAL); Lohit district, Hayuliang, 15-11-1983, *K. Haridasan* 0074, buds (APFH); Metangliang, 23-3-1986, *K. Haridasan* 2882, buds (APFH); Lower Subansiri district, Drupang, 10-3-1983, *Buru Loda* 0551, buds (APFH); Old Ziro-Begi Road, s. date, *G. D. Pal* s.n., frts (ARUN); Dibang Valley, Desali, 14-3-1984, *K. Haridasan* 0794, buds (APFH).

*Notes* : The species is mostly confused with *L. cubeba* (Lour.) Pers. *L. kingii* Hook. f. is deciduous, and found to grow in cool broad-leaved coniferous forests at 1800 m to 2900 m whereas *L. cubeba* (Lour.) Pers. is evergreen, growing in sub-tropical and warm broad-leaved forests at 300 m to 1800 m. Moreover, leaves are more acute and elliptic in *L. kingii* Hook. f., branches stouter, leaf petiole shorter, umbel pedicel more stout, winter buds present, leaves thinly coriaceous while they are membranous in *L. cubeba* (Lour.) Pers. It has been aptly said by Kanjilal (1940) that "...the points of distinction (between *L. cubeba* and *L. kingii*) merge in intermediate forms". The species was known from Meghalaya (Kanjilal & al., 1940), Sikkim and West Bengal (Hooker, 1886; Long, 1984). Here, the species is reported for the first time from Arunachal Pradesh.

5. ***Litsea laeta*** (Wall. ex Nees) Hook. f., Fl. Brit. India. 5:169.1886; Kanjilal & al., Fl. Assam 4: 88. 1940; N.P. Balakr., Fl. Jowai 2: 403. 1983; D.G. Long in Grierson & D.G. Long 1984, Fl. Bhutan 1(2): 275. 1984. *Tetranthera laeta* Wall. ex Nees in Wall. Pl. As. Rar. 2: 67. 1831.

*Fl.*: November to February; *Fr.*: January to June.

*Habitat* : Evergreen and mixed forests from 300 - 900 m.

*Distribution* : India : Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, West Bengal. Bhutan, Nepal.

*Specimens examined* : Manipur, Soanac, 26-11-1885, 4000ft, *C. B. Clarke* 42152, frts; Mizoram, Mizo hills, *D. B. Deb* 30686, female fls (ASSAM); Nagaland, Naga Hills, June 1935, *N. L. Bor* 21168, male fls (ASSAM); *N. L. Bor* 17418, male fls (ASSAM).

*Notes* : The species is a common element of the Eastern Himalayas and is reported from Arunachal Pradesh, Assam, Meghalaya (Kanjilal & al., 1940) and Sikkim (Long, 1984), Tripura (Deb, 1981) and West Bengal. Herbarium study reveals that it is also present in Manipur, Mizoram and Nagaland.

6. ***Litsea nitida*** (Roxb. ex Nees) Hook. f. Fl. Brit. India. 5:174.1886; Prain, Bengal Pl. 2: 676. 1903; Haines, Bot. Bihar & Orissa 795. 1924; Kanjilal & al., Fl. Assam 4: 90. 1940; Mooney, Suppl. Fl. Bihar & Orissa 131. 1950. *Tetranthera nitida* Roxb. ex Nees in Wall. Pl. As. Rar. 2: 67. 1831; 3: 31. 1832.

*Fl.*: August to November; *Fr.*: October to April.

*Habit* : Tropical forests.

*Distribution* : India : Arunachal Pradesh, Assam, Bihar, Nagaland, West Bengal. Bangladesh, Myanmar, Nepal.

*Specimens examined* : Arunachal Pradesh, Lower Subansiri district, Doimukh, 18-4-1978, *G. D. Pal* 75871, buds (ARUN); Nagaland, Aka Hills, *N. L. Bor* 18961, buds (ASSAM, CAL).

*Notes* : The species was reported from Bihar (Haines, 1924), West Bengal (Prain, 1903) and Assam (Hooker, 1886; Kanjilal & al., 1940). Its distribution is reported here from Arunachal Pradesh and Nagaland.

7. ***Litsea panamanja*** (Nees) Hook. f., Fl. Brit. India. 5: 175. 1886; Prain, Bengal Pl. 903. 1903; Parkinson, For. Fl. Andaman Is. 226. 1923; Allen in Ann. Missouri Bot. Gard. 25: 380. 1938; Kanjilal & al., Fl. Assam 4: 90. 1940. *Tetranthera panamanja* Nees in Wall., Pl. As. Rar. 2: 67. 1831.

*Fl.*: March to June; *Fr.*: July to October.

*Habitat* : Subtropical forests of Himalayas, 300 – 700 m and in Andaman islands.

*Distribution* : India : Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Nagaland, Sikkim, Tripura, West Bengal. Bhutan, Myanmar.

*Specimens examined* : Arunachal Pradesh, Tirap district, Ninsa to Wanu, 1141m, 1-9-1958, *G. Panigrahi* 15015, female buds (CAL, ASSAM); Nagaland, Naga Hills, June 1936, *N. L. Bor* 21166 (ASSAM).

*Notes* : The species was earlier reported from Assam (Hooker 1886; Kanjilal & al. 1940) and Tripura (Deb, 1981) in northeast India. It is reported now to Arunachal Pradesh and Nagaland.

8. ***Litsea sericea*** (Wall. ex Nees) Hook. f., Fl. Brit. India 5: 156. 1886; Allen in Ann. Missouri Bot. Gard. 25: 369. 1938; Kanjilal & al., Fl. Assam 4: 82. 1940; Hara, Fl. E. Himal. 1: 102. 1966, 2: 39. 1971; 3: 186. 1982. *Tetranthera sericea* Wall. ex Nees in Wall., Pl. As. Rar. 2: 67. 1831.

*Fl.*: April to November, *Fr.*: September to December.

*Habitat* : Temperate forests, from 2000 – 3100 m.

*Distribution* : India : Arunachal Pradesh, Manipur, Sikkim, West Bengal. Bhutan, Myanmar, China, Nepal.

*Specimen examined* : Arunachal Pradesh, Lohit district, Mailong, 1800 m, *s. coll.* 2338, buds (APFH).

*Notes* : Hooker (1886) and Kanjilal & al. (1940) recorded the species from Manipur and Long (1984) from Sikkim. The species is reported for the first time from Arunachal Pradesh.

9. ***Litsea thomsonii*** (Meisn.) Hook. f., Fl. Brith India 5: 170. 1886; Kanjilal & al., Fl. Assam 4: 89. 1940. *Tetranthera thomsonii* Meisn. in DC., Prodr. 15 (1): 183. 1864.

*Fl.*: September to January; *Fr.*: January to April.

*Habitat* : Evergreen and mixed forests of low hills in northeast India.

*Distribution* : India: Assam, Meghalaya. Bangladesh.

*Specimens examined* : Meghalaya, Nondongiri, 300 m, 30-11-1996, *Shankar Das* 105221, frt (ASSAM); Khasi Hills, 10 km point on way to Mawsynram from Balak, 9-5-1975, *G. K. Bhaumik* 62093, frt (ASSAM); Khasi & Jaintea Hills, between Nongpoh and Umling, 1700 ft, 2-6-1914, *U. Kanjilal* 4008a, buds (ASSAM); Khasi Hills, Nongpoh, 1820 ft, 30-5-1914, *U. Kanjilal* 3975, female fls (ASSAM); Khasi & Jaintea Hills, near the village Tuber, 1450 m, 24-7-1965, *N. P. Balakrishnan* 42934 (ASSAM); Khasi & Jaintea Hills, above Mahadeo, 3200 ft, 19-10-1914, *U. Kanjilal* 4625, frt (ASSAM); Khasi & Jaintea Hills, 39 miles, G. S. Road, *Shri Ram Sharma* 13278, female buds (ASSAM); Khasi & Jaintea Hills, 37 miles G. S. Road, 6-6-1914, *U. Kanjilal* 4048, male buds (ASSAM).

*Notes* : The species was recorded from Bangladesh (Hooker, 1886) and Sibsagar in Assam (Kanjilal & al., 1940). Presently it is reported from Khasi, Jaintia and Garo hill tracts in Meghalaya. All these specimens were wrongly identified as *L. laeta* (Wall. ex Nees) Hook. f. in the herbarium.

10. ***Litsea lancifolia*** (Roxb. ex Nees) Hook. f., Fl. Brit. India. 5: 159. 1886; Prain, Bengal Pl. 902. 1903; Allen in Ann. Missouri Bot. Gar. 25: 395. 1938; Kanjilal & al., Fl. Assam 4: 84. 1940; Kosterm., Bibl. Laur. 837. 1964; Haridasan & Rao, For. Fl. Meghalaya 2: 731. 1987. *Tetranthera lancifolia* Roxb., ex Nees in Wall., Pl. As. Rar. 2: 65. 1831.

*Fl.*: January to May; *Fr.*: May to September.

*Habitat* : Tropical and Sub-tropical forests of Eastern Himalayas and hills of northeast India.

*Distribution* : India : Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Sikkim, Uttarakhand, West Bengal. Bhutan, China, Myanmar, Nepal.

*Specimen examined* : Nagaland, Jabocka, 4000 ft, April 1899, *Dr. Prain's collector* 946, female fls. (CAL).

*Notes* : This is the only species of *Litsea* Lam. from the northeast India that possesses opposite leaves. Hence it is easily distinguished from other species. It was reported from Arunachal Pradesh, Assam, Meghalaya (Hooker, 1886; Kanjilal & al., 1940; Haridasan & Rao, 1987) and West Bengal (Prain, 1903). Presently it is reported from Nagaland based on Prain's collection.

#### ACKNOWLEDGEMENTS

Authors are thankful to the Director, Botanical Survey of India, Kolkata. For facilities and award of Flora of India Research fellowship to one of us (TB). The permission by the keepers to consult herbaria at APFH, ASSAM and CAL. is gratefully acknowledged.

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## NOTES ON THE NEWLY PUBLISHED SPECIES *PERSEA HIMALAYAENSIS* M. GANGOP. (LAURACEAE)

M. GANGOPADHYAY AND V. S. KUMAR\*

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Gangopadhyay (2006) described a new species, *Persea himalayaensis*, by elevating an unnamed variety of the species *Machilus odoratissima* Nees, *â* Nees (in Wall., Pl. Asiat. Rar. 2: 70. 1831). The type specimens cited are the same as that of the variety *â*, Wall. Cat. 2607A (as 2601A), *pro parte* (CAL); 2607B (CAL); 2607F (CAL) and not specified name of the type. In addition to this, many specimens from different localities of India, Bhutan, Nepal and Pakistan were listed.

The name *P. himalayaensis* was not validly published because no single type was designated for this new binomial as per Art. 37.1 (ICBN, 2006) which defines the type of the name must be indicated on or after 1st January 1958. Further, Art. 37.6 states that the name of a new taxon published on or after 1st January 1990, indication of the type must include one of the words *holotypus* or its abbreviation, or its equivalent. According to Art. 9.1, a holotype is the one specimen used by the author, or designated by the author as nomenclatural type.

Although this species is described recently, Hooker (1886) doubted the amalgamation of more than one species in *Machilus odoratissima* and its syntypes Wallich Catalogue numbers 2607A-F by stating, "I am very much puzzled with this plant, and suspect that it consists of several species ..... other form is Wallich's 2607B from Kumaon, with glabrous panicles ..... with oblong fruit". Since the specimen of Wallich Catalogue number 2607B is more pertinent to the diagnostic characters provided by Gangopadhyay (*l.c.*), the same is designated here as lectotype.

***Persea himalayaensis*** M. Gangop. ex M. Gangop. & V. S. Kumar **sp. nov.** *Machilus odoratissima* Nees in Wall., Pl. Asiat. Rar. 2: 70. 1831, *pro min. parte, quoad* var. *â* Nees; Hook. f., Fl. Brit. India 5: 139. 1886, *pro parte*.

*P. odoratissimae* (Nees) Kosterm. affinis, sed differt inflorescentis glabris, fructibusque oblongis, ovoideo-oblongis vel ellipsoideo-oblongis.

*Lectotype*: India, Uttarakhand, Montes Prope Dehra Dhoon (probably from Kumaon, Herb. *Strachey and Winterbottom*), Wall. Cat. no. 2607B (CAL, designated here; K-W, microfiche seen at MH).

*Syntypes*: Nepal, *sine loc. & coll.*, 1821, Wall. Cat. no. 2607A (CAL; K-W, microfiche seen at MH, *pro parte*, only LH specimen); ? Singapur, *sine loc. & coll.*, 1822, Wall. Cat. no. 2607F (CAL; K-W, microfiche seen at MH).

*Paratypes*: All the specimens cited by Gangopadhyay (*l.c.* 136, Wallich specimens excepted).

### ACKNOWLEDGEMENTS

The authors are grateful to Dr. Dan H. Nicolson, Smithsonian Institution, USA, for kindly clarifying certain nomenclatural queries. Facilities provided by the Director, BSI, and Joint Directors of BSI, Kolkata/Howrah and Hyderabad are greatly acknowledged.

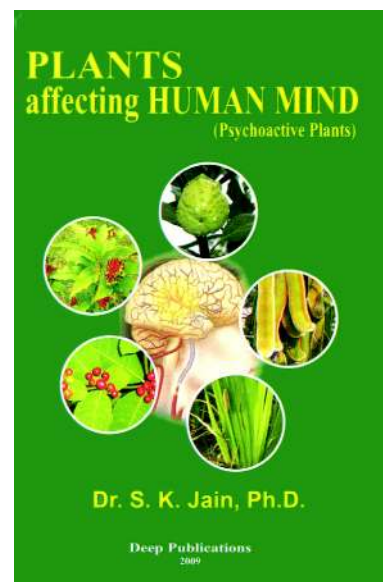
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## BOOK REVIEW

**Plants affecting Human Mind (Psychoactive Plants)** by Dr. S.K. Jain, published by Deep Publications, New Delhi, 2009. ISBN : 81-85622-19-1, Price : Rs.700.00 or \$ 70.

The book essentially focuses on psychoactive plants and the author, formerly the Director of Botanical Survey of India and founder Director of Institute of Ethnobiology, very aptly explains that the word psychoactive is more a generic term and varied terminology such as analgesic, anesthetic, anodyne, antidepressant, euphoriant, excitant, hallucinogenic, sedative, hypnotic etc. are used for different specific conditions. Also, the terms used for various medical conditions in humans such as apoplexy, delirium, convulsion, epilepsy, hemiplegia, hysteria, insanity, melancholia, neuralgia, neuritis and stupor are given in elaboration for the reader to be conversant and to well relate various medical conditions with curative nature of plants. The chemicals derived from this recognized group of plants are employed in different cited domains of psychiatry. It was realized that there is no special documentation wholly devoted on this important group of plants. The publication is the result of a careful scrutiny of all available literature on psychoactive plants and also based on author's own work. The book contains 8 sections which include introduction (1), botany and psycho activity (2), chemistry (3), psycho activity index (4), family index (5), common names index (6), addendum (7) and literature cited (8). In section 2, about 300 plants were enumerated; species were alphabetically listed by botanical names under each family. Families were again listed alphabetically. Synonymy was avoided and whether it reduces clarity on the name referred to? Local names were given without the language or dialect indication and English names, to distinguish them from others, were given in capital letters. Brief description (drawings help out to a great extent in recognition than limited descriptions!), distribution and psychoactive properties were given. Parts used for the purpose were not specified. Chemistry of selected species with significant chemical constituents was included separately, and in most cases, chemistry related to specific body parts, under section 3. In this enumeration even author names were given in bold by oversight. Several relevant references were linked to the stated subject and claims that have been made earlier and also in the Indian context. While going through these sections, one feels that an integration of qualities attributed with the chemistry of taxon is missing. In fact these two sections (2&3) should have been presented under one with ample notes on realized virtues, indication of knowledge gaps and possibilities for future research. The author has taken great care to facilitate effortless location of desired psychoactive property, the botanical families and the common names in three indexes in the book (4-6). A list of 38 plants was added as they were reported very late but prior to publication under addendum (7) to make it up-to-date and also with the purposes of not to miss out any plants that exhibit psycho activity even at low level. The book is generously illustrated with over 100 line drawings and 16 colour plates. This work facilitates field researchers in ethnobotany to be more objective and critical in their enquiry and to look into promising prospects of these plants. With advances in molecular biology particularly in genetic engineering, gene translocation and drug designing, future researchers may use gene wealth of these taxa for any medical challenges that might crop up with modernization and coupled faster pace of life in the years to come. The book deserves a place in all libraries that are attached to academic / research institutions engaged in botanical research, ethnobotany, forestry, medicinal plants, pharmacognosy, biotechnology / molecular research. More importantly, the author who is a very senior and eminent person in his chosen field of research in ethno/economic botany deserves approbation for his consistent and determined pursuit to see the publication through in spite of his advancing age.



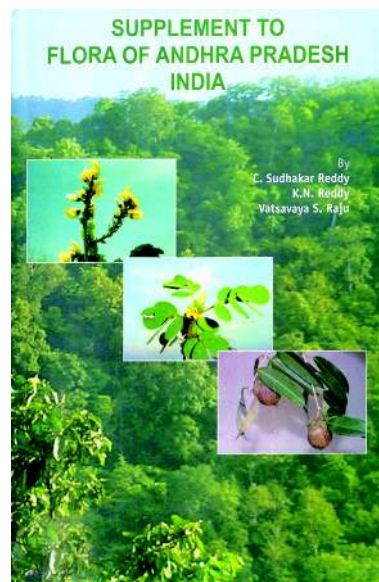
M. SANJAPPA & P. VENU  
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## BOOK REVIEW

**Supplement to Flora of Andhra Pradesh, India** by C. Sudhakar Reddy, K.N. Reddy, Vatsavaya S. Raju, published by Deep Publications, New Delhi, 2008. ISBN : 81-85622-17-3, Price : Rs.600.00.

The book under review, compiled by Drs. C. Sudhakar Reddy, K.N. Reddy & Vatsavaya S. Raju, has added 272 species to the Flora of Andhra Pradesh and with this inclusion, the state accounts for about 2803 species belonging to 1051 genera under 185 families. Such publications usually do not require a separate review if they are in tune with earlier published flora on the state. In fact while planning such a publication, the authors are supposed to adopt some guidelines (even if they are self imposed!) and these are to be elaborated either in the introduction or in the methods. These are to be followed consistently to keep up some order all through the text. This is not done fully and where it is stated, it is not carried over. The result is that there is no uniformity for various species. There was no rationale in works mentioned/chosen under citation. Floras as distant as Flora China (Page 29) and Flora Dehradun (Page 13) were quoted for reasons known only to authors for certain species. The purpose of citation is to give the correct name and also a glance on how the taxon under reference was quoted with other names in various floras and effectively link correct name with synonyms. In a state flora, this is expected in the order of the original citation followed by relevant regional flora and the district flora/other works / the present work from where the taxon under reference was reported for the first time to the state. Standard conventions were not allowed while citing both for author names and also established floras. Far worse is that the abbreviations used in the citations are varied from species to species. Authors' names are usually abbreviated following Brummit and Powell (1992) and for that of titles of books *Taxonomic literature* ed. 2 (Stafleu & Cowan, 1976-88). For periodicals, *Botanico-Periodicum-Huntianum* (Lawrence & al., 1968) and *Botanico-Periodicum-Huntianum / Supplementum* (Bridson & Smith, 1991) are usually followed. There was a great divergence in the abbreviations applied for established works (Flora of British India, Wallich's Catalogue, De Condoll's Prodrum, *Plantae Asiaticae Rariores*, Gamble, Fl. Madras, Wight Icones, Flora of India). In integrated works, authors of various families were given in the citation for certain species (Page 30, 32, 33 & 36) and for others only the titles of publication (Page 25, 26) were given. Journals were italicized (Page 19, 24, 25) in some places and not in other places (Page 30, 68). Usually, page number of the cited name with the description is quoted and not the whole page range where this article appeared (Page 7, 14, 17 & 19). For certain species, page numbers of both original publication and reproduced editions were given (Page 26, 27) for floras like that of Madras Presidency. Four species were described new after Flora of Andhra Pradesh (1997) and while reporting these species, the location of types should have been given more appropriately which was avoided for some of them and their names were also excluded in index given at the end. The citation referring to the first report for the state was unfortunately not included in the citation (Page 34). This was given under the notes.



The reviewers happened to see Flora of Andhra Pradesh Vol.5 (Addition, Floristic Analysis and Further Illustrations) published by Pulliah & Karuppasamy during same year (2008). The volume contains about 82 pages text followed by illustrations. It has essentially enumeration of missed out plants in Flora of Andhra Pradesh published in 3 volumes (1997). Many of the species included there are also in the present supplement and descriptions were much same in both the works. The punctuation in descriptions was thrown to winds. For few genera, the component species were keyed out (Page 8, 79) but for majority others, it was left out. While citing specimens, the authors have not given the dates which should have given some clue whether the taxon under consideration was a missed out old collection or a new collection after the publication of Flora of Andhra Pradesh (1997). The measurements given for morphological features did not agree between the tables and descriptions (Page 17, 18) and also between the descriptions and keys (Page 18 and 19). The authors with little more effort on their part could have done it much better. Taxonomy, as such, is voluminous and carelessly done errors further burden the subject than serving the purpose. Further, such works add no glory to authors who are considered established in their chosen field.

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## BOOK REVIEW

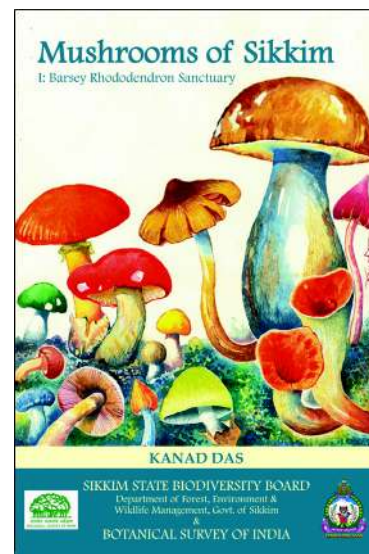
**Mushrooms of Sikkim - I: Barsey Rhododendron Sanctuary** by Kanad Das, published by Sikkim state Biodiversity Board, Gangtok-737102 & Botanical Survey of India, Kolkata, 2009, 160 pp, all coloured on art paper. Paperback edition ISBN: 978-81-909680-0-3, Price Rs 600/-

Field guide on Mushrooms of Sikkim (Barsey Rhododendron Sanctuary) by Dr. Kanad Das is an illustrated authoritative document which gives a glimpse of rich mushroom diversity in that area. As far as my information goes it is first book of its kind, dealing with field characterization of Indian Mushrooms belonging to Phylum Ascomycota and Basidiomycota, by an Indian Scientist.

The comprehensive introductory chapter clearly outlines the major morphological features besides giving details about various aspects including collection of material, taking spore print, seasonal variation in the study area and precautions required to be taken while working on these fungi. A handy workable key for the identification of documented species based purely on field characters has added to the utility of this field guide to the beginners and amateur workers.

The main body of the book contains information about each documented mushroom for which, besides good quality field photographs, information about scientific name, common name, local name, season of occurrence, distribution, habitat, edibility, field characters and basidiospore characters have been given. Availability of all these features at one place makes this field guide more user friendly for easy identification of the mushrooms available in the Barsey Rhododendron Sanctuary and other similar habitats of North East and other parts of the country. For the common man and beginners the author has segregated the edible and inedible harmless mushrooms from the poisonous mushrooms by a danger signal next to the species name which will help the user in staying away from such mushrooms while gathering them for consumption or selling in the market.

Towards the end of the book, incorporation of the information about edibility, nutrition, medicinal value, poisoning, threat perception and conservation makes it more informative and complete from field utility point of view. A full page of the field guide has been devoted to mushroom poisoning and mushroom toxins. This portion is a must for any book dealing with mushroom to make people aware of the ensuing danger of mushroom consumption without proper knowhow about the culinary credentials. Overall, it is a commendable attempt, hope Dr. Das with zeal for exploratory work will continue and extend his area of operation to the whole of North East.



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To  
The Editor  
Bulletin of the Botanical Survey of India  
Kolkata.

Letter to the Editor

Sir,

This writer is closely associated with two scientific societies, namely **Society of Ethnobotanists (SEB)** and **Association for Plant Taxonomy (APT)** since their foundation. Both societies have recently initiated two new activities. Publication of Scholastic Genealogies was started last year, and this year Mentor-Mentee Programme is being initiated.

During talks with some members of these societies, I got an impression that some points about objectives and procedures of these activities needed elaboration. These two activities are quite different; and perhaps the only commonality is the use of the term mentor in some western countries for the guide of Ph.D. research.

**Scholastic Genealogies (SG):** The term genealogy here means academic inheritance or the chain of research guide and students who got doctoral degrees. The word scholastic is adjectival form of the word scholar. We know that some very able and active research workers in our country initiated and so organised or expanded certain disciplines or aspects of scientific research that they became well known for that subject and attracted scholars from far and wide to do research and get doctorates with them. Some 'products' of such schools created new centres in same discipline, and one can sometimes see four or even five generations of successful doctoral students. A faithful documentation of these generations of students, and their students is scholastic genealogy. These genealogies provide information on name of Ph.D. student, topic / title of thesis, year of award, and name of university. (For details see *Bull. Bot. Surv. Ind.* 49 : 238-243. 2007; *Phytotaxonomy* 7 : 116-119. 2007; *Nation. Acad. Sci. Lett.* 32: 65-68. 2009).

**Mentor-Mentee programme** is not so structured an activity; it is voluntary and informal. Young, upcoming researchers have hundreds of questions in their mind on matters of professional scientific or even personal advancement, such as further research work, choice of topic for their students, choice of career (teaching, research, industry, entrepreneurship, etc.), choice of institution, guide, place of work, sources of funds for research, openings for jobs, proper writing of application or C.V. preparation for interview or Group Discussion. Many young ambitious scholars, particularly in smaller towns, very often experience a serious handicap of not readily finding at their place of work any senior, knowledgeable, experienced and willing person for advice or guidance. This program can be helpful for such person.

**The initiative has to come from** inquisitive, serious and sincere workers. They can approach one or more senior persons whom they think can be helpful to act as their Mentor, providing as much information as possible about themselves (personal & scientific), and few main areas of their queries.

A Mentor is expected to give similar sincere guidance and affection as he will do to his own kith and kin or doctoral students. The mentee is expected to give similar respect, regard and service as he will give to his elders in the family or to his teachers.

Many senior members of SEB and ATP have shown willingness to act as Mentor.

Once a good rapport is established, these associations can be very fruitful and long-lasting. The system already exists in some R & D organisations in our country.

**S.K. Jain**

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## INSTRUCTIONS TO CONTRIBUTORS

Nelumbo is a journal primarily meant to publish results of taxonomic research. It is open to researchers in India and abroad working in plant taxonomy, biosystematics, ethno- and economic botany, phytogeography, endemism and studies related to recognition and conservation of IUCN red-listed plant categories. Original articles, critical reviews and short communications are usually considered for publication. Mere compilations of published materials missing analysis, scientific argument and worthwhile conclusions are summarily rejected.

Manuscripts, neatly computer typed in double space with adequate margin on a good quality A4 paper with pagination indicated on upper right hand corner, should be submitted in duplicate. Illustrations in original and photographs on a glossy paper, not smaller than 15 × 9 cm, should be submitted. Illustrations and photographs should be numbered by Arabic numerals. Acknowledgements should be precise and should be at the end but prior to references cited. An abstract (c. 150 words) in English and Hindi should be included for all papers and reviews but not for short communications. In addition, the authors must send soft copy of the manuscript on a CD in MS Word or PageMaker. We encourage the submission of manuscripts by email to **bulletinbsi@gmail.com**. In papers on floristic enumeration, the correct names of plants with authority should be given. Specimens cited in the text are to be deposited in one of the BSI Herbaria or in any other recognized herbarium (in case of other institutions) and this is to be clearly specified through acronyms.

New reports and new records for India and for different phytogeographical regions of the country should include notes on habit, habitat and associated plants. It is desired that several new records together, and not one or two, appear in a paper. In case of new taxa, holotypes or isotypes are to be deposited at the Central National Herbarium (CAL).

Monographs and revisions on specific taxon/taxa, the authors should give details in the order specified below in the citation of concerned taxon: (1) the correct name with its authority and citation (2) in case of a combination the basionym with its citation and (3) synonymy in chronological order. Only bracketed keys are to be employed while keying out the species.

Standard book/flora abbreviations (Taxonomic Literature, ed. 2, Stafleu & Cowan, 1976-1988 & its Supplements 1 – 6 by Stafleu & Mennega, 1992-2000) standard journal/periodical abbreviations (Botanico-Periodicum-Huntianum, Lawrence & al, 1968; Bridson & Smith, 1991 & Botanico-Periodicum-Huntianum, ed. 2, 2004) and standard author abbreviations (Authors of Plant Names, Brummit & Powell, 1992) are to be followed and with consistency.

Papers on biosystematics and plant chemical analysis should indicate (1) the institution where the work was carried out, (2) the expert/ institution where the plant or plant part employed in investigation is identified and (3) the field number of voucher specimen with the Herbarium acronym where it was deposited. Tables should be reduced to the bare minimum.

In taxonomy related papers, literature should include only those references cited in introduction and discussion and not the ones cited in taxonomic citation of individual taxa. For others all references cited in the text should be included. The format for bibliographic citations will be as follows:

For quoting original works

GAMBLE, J.S. 1915 – 1936. Flora of the Presidency of Madras. 11 Parts. Adlard & Son Ltd., London.

HOOKE, J.D. 1872-1884. The Flora of British India. 7 Vols. L. Reeve & Co., London.

While quoting reprinted edition

GAMBLE, J.S. 1957. Flora of the Presidency of Madras. 3 Vols. BSI, Calcutta.

While quoting a particular family

CLARKE, C.B. 1884. Acanthaceae. In: J.D. Hooker (ed.). The Flora of British India 4: 387 – 558. L. Reeve & Co., London.

For quoting a particular chapter in a book

SUBRAMANYAM, K. AND M.P. NAYAR. 1974. Vegetation and Phytogeography of the Western Ghats. In: M.S. MANI (ed.), Ecology and Biogeography of India. 178 – 196. The Hague, Netherlands.

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OHASHI, H. 1973. The Asiatic species of *Desmodium* and its allied genera (Leguminosae). *Ginkgoana* 1: 1 – 318.

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GANDHI, H.P. 1958. A list of flowering plants. *Vidya J. Gujarat Univ.* 2: 114-156.

The titles of books and papers should be in regular font while the titles of periodicals should be in italic font. The first author surname is first whereas for others, it goes at end. The year of publication will be after the authors' names. The names of publisher are to be cited followed by the place of publication in case of books only.

For better grasp, the contributors are advised to refer to recent issue of the Nelumbo.

Proofs are sent to the authors at the discretion of the editor and must be returned within three days of receipt. 25 reprints will be sent to the corresponding author on gratis.

Matters pertaining to publication of papers and subscription must be addressed to **the Director or the Scientist -In -charge, Publication Section, Botanical Survey of India, CGO Complex, 3rd MSO Building, Block-F, 5th & 6th Floor, DF Block, Sector – I, Salt Lake City, Kolkata – 700 064.**  
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